AUTOMATIC REELING MACHINE

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ABSTRACT

An automatic reeling machine constructed so as to automatically operate continuous steps of winding a certain amount of thread on each of several reels to form a hank thereon, of lacing a tie-band on said hank thus formed and of removing said laced hank from the reel, so that substantial automation of all manufacturing processes of the laced hank can be achieved. The laced hank manufactured by the automatic reeling machine of this invention contains a constant amount of thread without breakages and can be easily released of a knot positioned adjacent to the terminating end of the thread without entangling, so that an easy-to-handle hank of high quality can be obtained.

33 Claims, 22 Drawing Figures
AUTOMATIC REELING MACHINE

The present invention relates to an automatic reeling machine, and more particularly to an automatic reeling machine having a plurality of reeling units whereby the thread from a cheese or bobbin is continuously in an automatic manner wound on each reel to form a hank containing a predetermined amount of the thread such as a knitting wool or the like.

The automatic reeling machine of this invention is provided with reeling units each including a circular reel of an axial length sufficient for a single hank to be wound thereon, a driving means for rotating said reel and a feeding means for supplying the thread from a cheese or bobbin to said reel, thereby the winding operation to form the hank on said reel being performed independently for each reeling unit resulting in the facilitated management of the winding operation as a whole.

One object of the present invention is to provide a detector in each of said reeling units, said detector being effective to detect the existence of a thread to be fed thereto and to detect the completion of the winding operation thereto for the purpose of reliably securing the reeling operation of the said reeling unit in the automatic reeling machine.

Another object of this invention is to provide a locking means in each of said reeling units said locking means being effective to stop the corresponding reel at a predetermined position upon rotation thereof in a predetermined constant rotational frequency, for the purpose of reliably securing thread thereto to form a hank containing a desired amount of the thread on said reeling unit.

A further object of the invention is to connect a lacing device and its associated knottor with any one of said reeling units having a hank, said lacing device and its associated knottor being effective to form a tie-band with the starting and terminating ends of the thread on a hank and bind them to form a knot thereof, for the purpose of furnishing a laced hank on said reeling unit.

A further object of the invention is to provide a thread end retainer in each of said reeling units, said thread end retainer being effective to move the knot thus formed on the laced hank by the knottor from the initially knotted position on the tie-band to a position somewhat apart therefrom for the purpose of facilitating an untying of the laced hank during the use thereof.

A further object of the invention is to connect a doffer with each of said reeling units, said doffer being effective to remove and collect the laced hank from each of the reels for the purpose of automatic removal of the hank from said reeling units.

The automatic reeling machine of this invention is so constructed as to automatically operate continuous steps of winding a certain amount of thread on each reel to form a hank thereon, of lacing a tie-band on said hank thus formed and of removing said laced hank from the reel. This arrangement providing substantial automation of all manufacturing process of the laced hank can be achieved.

Furthurmore, the laced hank manufactured by the automatic reeling machine of this invention contains a constant amount of unbroken thread which can be easily released of its knot positioned adjacent to the terminating end of the thread without entangling, so that the easy-to-handle hank of high quality can be obtained.

These and other objects and aspects of the invention will be more clearly understood form the following description of an embodiment of the invention shown, by way of example only, in the accompanying drawings in which:

FIG. 1 is a top plan view of an embodiment of an automatic reeling machine according to the invention;
FIG. 2 is a side elevational view taken along the line II — II of FIG. 1;
FIG. 3 is a side elevational view taken along the line III — III of FIG. 1;
FIG. 4 is an enlarged side elevational view of the essential part of FIG. 2;
FIG. 5 is a front elevational view of one part of FIG. 4;
FIG. 6 is an enlarged side elevational view of one part of FIG. 3;
FIG. 7 is a front elevational view of another part of FIG. 3;
FIG. 8 shows an enlarged isometric view showing a part of FIG. 2;
FIGS. 9a and 9b show schematically enlarged back elevational views showing a part of FIG. 8;
FIGS. 10a, 10b, 10c, 10d, 10f, 10g, 10h, 10i, 10j and 10k show isometric views illustrating the operation of the essential part of FIG. 1; and
FIG. 11 is an isometric view of a laced hank produced by the machine of FIG. 1.

The automatic reeling machine of the present invention comprises a turreted turntable A having a plurality of mounting arms radially extending therefrom and effective to rotate around a shaft 39 which is intermittently driven by a main drive device C; a plurality of reeling units B each mounted on the end of each mounting arm 5 of said turntable A and each including a reel, a reel rotating means, a feeder for supplying the thread from a cheese or bobbin to said reel, a detector D, a locking means F for stopping the reel at a predetermined position about the axis of rotation of said reel and a thread and retainer G effective to move a knot on a tie-band formed with the starting and terminating ends of the thread from the initially knotted position to a position somewhat apart therefrom; a set-off device E including a set device E' and an off device E" and adapted to control the reel rotating means of the reeling units B; a lacing device H positioned at a fixed place for forming a tie-band with the starting and terminating ends of the hank formed on the reel; a knottor I effective to bind the tie-band thus formed for making a knot; and a doffer J effective to remove and collect the laced hank from the reel.

Each of the reeling units B is arranged to function in the following manner: While the turntable A with the reeling units B is intermittently rotated by the main drive device C to establish one revolution, the reel rotating means is first actuated by the set device E', causing the reel to rotate the thread from the feeder as said reel is rotated. At this time, the detector D is also operated as will be mentioned later. However, this detector D acts to cause the locking means F to stop the reel rotating means when the winding or reeling operation completes or when the thread is found not to exist between the feeder and the reel. The abovementioned winding operation undergoes during rotation of the turntable A and, however, when each one of the reeling units B which completes the winding operation is brought into register with the lacing device H which is confirmed by the off device E" , the turntable A is intermittently stopped thereby to permit the lacing device H to connect to the reeling unit by which a tie-band can be formed with the starting and terminating ends of the thread. Upon completion of the operation of the lacing device H, the turntable A is rotated to the next position in which the tie-band thus formed can be tied to make a knot by the knottor I and, thereafter, the doffor J acts to remove the finished unit hank from the reel while the knot thus formed is shifted from the initially knotted position to another position somewhat apart therefrom by means of the thread end retainer G and subsequently to place the hank in a suitable receptacle provided on the doffer J.

Referring to the attached drawings, each of the reeling units B includes a spider reel 2, a reel rotating means 3 for driving the reel 2 and a feeder 4 including a spindle 24 and a cheese 23 for supplying the thread from a said cheese 23 to the reel 2,
all mounted on a framework 1 of the reeling units which is rigidly connected to the end of each of the arms 5 of the turntable A as shown in FIG. 4 through FIG. 6. The reel 2 includes a reel shaft 6 journaled in the framework 1, a plurality of stationary and movable arms 7 and 8 radially extending at rights to the rotary shaft, stays 9 extending from the pointed ends of said arms 7 and 8 at right angles thereto, a retainer bar 10 effective to retain the starting end of the thread from the cheese 23, the thread end retainer G effective to retain the terminating end of the thread from the cheese and comprising a stationary bar 12 and a movable bar 13 for the movable arms 8, a rotary disc 14 fixed to the rotary shaft 6 and a connecting rod 15 operatively connecting between the movable arm 8 and movable arm 12. In this arrangement, each reel 2 is operable in such a manner that, when the rotary shaft is rotated by the reel rotating means through the rotary disc, as will be hereinafter described, after the starting end of the thread T supplied from a cheese is retained by the retainer bar 10, the reel 2 is rotated integrally with the stationary and movable arms 7 and 8 wound with the thread lying on each of the stays arranged to correspond with the respective apexes of a substantially multangular shape, and after the winding operation is completed the terminating end of the thread is retained by the thread end retainer. Thus when a unitary hank comprising a desired amount of thread is formed on the reel and subsequently the reel is stopped at a predetermined position about its own axis the facing device H is connected to the reel having the hank thus formed thereon to form a tie-band with starting and terminating ends of the thread, as will be hereinafter described, and at the same time to release the starting end of the thread from the retainer bar while separating the terminating end thereof from the thread end retainer. Thereafter, the doffer J is connected to the reel whereby the movable arms 13 are moved by the operating bar toward the rotary shaft to loosen and remove the hank from the reel, and at the same time the movable arm 12 of the thread end retainer is connected therewith to displace the knot formed with the tie-band from the position where the tie-band was originally formed on the hank.

Each of the reel rotating means 3 includes, as best shown in FIG. 8, a motor 16 to be actuated by the set device E', a high speed roller 18 driven by said motor through a gearing 17, a low speed roller 20 driven by said motor through the gearing 17 and a reduction gear 19. A changeover lever 21 is provided which is effective to contact either the high speed roller or the low speed roller against the rotary disc 14. When the motor 16 is actuated by the set device E', a primary electro-magnetic means 22 is not in operation at this time and therefore the change-over lever 21 is positioned so as to cause the high speed roller 18 to contact to the rotary disc so that the reel is rotated at high speed about its own axis through the rotary disc. Subsequently, as the primary electro-magnetic means 22 is actuated makes to, the change-over lever makes to disengages the high speed roller from the rotary disc and engages the low speed roller to the rotary disc, resulting in that the reel is rotated at low speed. The off-device E' is effective to stop the motor and at this time the locking means F is operated as will be mentioned later so as to stop the reel 2 at a predetermined position about its own axis.

Each of the thread feeding means 4 includes a cheese 23, a spindie 24 to which said cheese is mounted, a tension mechanism 25 effective to adjust the tension of the thread from said cheese to 16 through said guide bar 26, and a three-stage change-over mechanism 27 effective to make the guide bar 26 among first, second and third positions, said change-over mechanism 27 being operable in connection with the detector D so that the thread from the cheese is wound on the right side of theGuide bar as the guide bar is positioned at the third position, while on the left side of the guide bar the winding is positioned at the second position. However, when the guide bar 26 is positioned at the first position, the thread from the cheese is caught by the thread end retainer G.

Each of the thread end retainers G includes particularly as shown in FIG. 7 and FIGS. 10a to 10k a stationary bar 11 having one end fixed to a framework of the reel 2 and the other end laterally outwardly extending with respect to the axis of the turntable A and a second bar 12. The detector D is operable in connection with an operating bar 13 in such a manner as to pull the terminating end of the thread T toward the outside of the reel for the purpose of shifting the knot S from the position where the tie-band S is originally formed to another position somewhat apart therefrom.

Each of the detectors D includes, as shown in FIG. 8, a counter K (FIG. 5) effective to count the number of revolutions of the reel 2, the primary electro-magnetic means 22 for operating the changeover lever 21, a secondary electro-magnetic means 28 for operating the locking device, a third electro-magnetic means 29 for operating the guide bar 26 and a detector switch 10 for detecting the absence or presence of the thread from the cheese to the reel, each of these three electro-magnetic means being operated when the counter K registers a predetermined number of revolutions of the reel 2. The counter and all of the electro-magnetic means are mounted on the framework while the detector switch is fitted to a thread holding portion of the guide bar 26. As the reel is rotated, the counter is at the same time actuated to register the rotational number of turns of the reel and to operate three electro-magnetic means in a sequential, namely first to operate the third electro-magnetic means 29. The third electro-magnetic means 29 operates the guide bar 26 and the detector rod 31 for the set-off device E, as will be hereinafter described, in the drivingly connected relationship through the change-over mechanism 27. For the purpose of describing the operation, by way of example it is assumed that it is desired to provide a hank of 1,000 windings. In this case the guide bar and the detector rod 31 are respectively positioned at the second position, and the device 26 is driven to the upper position by the set-device, and then a drive switch is actuated to drive the motor 16 for rotating the reel. As the reel rotates, a hank of 500 windings is first formed on the left side of the reel. Thus, when the first hank is completely formed, the third electro-magnetic means 29 is actuated to operate the change-over mechanism 27 so as to position the guide bar 26 at the third position and the detector rod 31 at the intermediate position, resulting in that a hank of the remaining windings, namely 500 windings, if formed on the right side of the reel. Finally, when the second winding is thus formed thereon, the third electro-magnetic means 29 is again actuated to operate the change-over mechanism so as to position the guide bar at the first position and the detector rod 31 at the lower position, thereby to register the completion of the winding. As shown in FIG. 10k, the thread supplied from the cheese is wound on the reel with a constant length sufficient to form the unitary hank of 1,000 windings. However, shortly before the third electro-magnetic means operates the guide bar to completely change from the third position to the first position, for example, 10 revolutions of the reel before the guide bar is positioned to the first position, the counter actuates the primary electro-magnetic means to cause the change-over lever 21, as hereinafter described, to disengage the high speed roller 18 from the rotary disk and, then, to engage the low speed roller 20 against the rotary disc 14, resulting in the reduction of the rotational velocity of the reel from high speed to low speed. Subsequently, when the reel is rotated with one revolution left to the predetermined number of revolutions, namely, in this instance, when the reel is rotated 999 revolutions, the counter may actuate the secondary electro-magnetic means 28 to cause the locking device F, as will be hereinafter described, to stop the reel at a fixed position of the framework just as the reel has completed 1,000 revolutions. Although the detector switch 30 is not in operation while the thread is fed from the cheese to the thread holding portion of the framework, if the absence of the thread from the cheese thereto and subsequently stop the motor for the reel rotating means add/or actuate the alarming device 32 as shown in FIG. 5 to issue an alarm.
The set-off device E comprises the set device E' having a set plate 33 effective to cause the reel rotating means 3 and the main drive device C to respectively rotate by converting the detector rod 31 from the lower position to the upper position, and the off device E'' having an off plate 34 effective to confirm the change-over of the detector rod from the intermediate position to the lower position and to detect the capability of advancing the reeling unit toward the lacing device H. arranged in the following process upon completion of the winding operation. Accordingly, while each of the reeling units being turned around the axis of the turntable together with the respective arms by means of the main drive device passes from the set plate 33 to the off plate 34, the reel is rotated in the predetermined number of revolutions to form a hank containing a sufficient amount of thread thereon. In the case where one of the reeling units approaches to the off plate and the detector rod thereof cannot be positioned at the lower position, an alternative course must be made in such a manner as to stop the rotation of the main drive device and then to form a hank containing a sufficient amount of thread on the rotating reel at the same position without advancing it toward the lacing device, and thereafter the main drive means is again operated to advance it toward the lacing device until the detector rod is depressed to the lower position by the off plate 34.

Each of the locking means F includes, particularly as shown in FIGS. 9a and 9b an engaging lever 35 operationally connected with the secondary electro-magnetic means 28 as hereinbefore described, a recessed portion 36 arranged on the rotary disc 14 for engagement by said engaging lever, and a switch 37 to be operated by said engaging lever 35 for stopping the motor for the reel rotating means. When the secondary electro-magnetic means 28 is operated by the counter, the engaging lever is displaced to cause an engaging piece 36 of said lever 35 to engage in the recessed portion 36 on the rotary disc, resulting in that the rotary disc ceases to rotate and the switch 37 (FIG. 9b) at the same time operated by the engaging lever 35 to stop the motor 16. In this case, since the rotary disc is rotated at low speed in engagement with the low speed roller by means of the primary electro-magnetic means, as hereinbefore described, while the engaging lever is in operation, the rotation of the rotary disc can reliably be stopped through engagement of the recessed portion with the engaging piece before it rotates one revolution. Furthermore, as the recessed portion is disposed on the rotary disc so that the reel 2 can be stopped at a predetermined position about own axis and the engaging lever is pivotally mounted on the frame work the reel can be stopped at the fixed position about its own axis of rotation through engagement of the recessed portion with the engaging piece of the engaging lever. In this fixed position of the reel, the starting and terminating ends of the thread supplied from a cheese are arranged to be positioned at the left side adjacent to the first hank formed on the left side of the reel with respect to the front plane of the reel.

The turntable A is designed to intermittently turn around the axis of the main shaft 39 by means of a main motor 40 of the main drive device C through a main gearing 41. For such main gearing employed to perform the intermittent rotation of the turntable, cams or cylinders or the like may be employed. As hereinbefore described, the turntable A has a plurality of radially extending arms 5 on which each one of said reeling units B is mounted, and adjacent to the circular path along which the reeling units are circulated integrally with the extended ends of the arms mounted therewith, the set and off devices E and E' lacing device H, knitter I and the doffer H are arranged at their respective fixed positions so that each of them may be associated with any one of the reeling units as they circulate around the axis of the turntable.

The lacing device H includes, particularly as shown in FIGS. 3 and FIGS. 6 a device body 43 provided with a drive apparatus 42 effective to approach to any one of the reeling units in driving connection with the main drive device C for forming a tie-band and thereafter to retract therefrom, a substantially circular hook 45 of vortex-shape arranged in front of the face surface of the device body so as to be reciprocatively rotated around the axis 44 thereof, a pair of left-hand and right-hand presser bars 46 and 47 arranged in front thereof, the two presser bars are formed at both ends of the device body, a cutter means 48 effective to cut the thread supplied from a cheese, and tools for arranging the thread in good order, and is arranged so as to associate with any one of the reeling units having a finished hank thereon. The lacing device of this construction can be operated in the following manner: Referring particularly to FIGS. 10e and 10f, when the lacing device is stationed at a position close to any one of the reeling units having a finished unitary hank consisting of two bundles of hank, each containing half a desired amount of the thread wound on the reel 2, the left-hand and right-hand presser bars 46 and 47 are forwardly moved as shown in FIG. 10(d) so that the corresponding bundles of hank can be backwardly depressed by respective pressing portions 50 and 51 of said bars 46 and 47 at different positions. While in this condition, a hook needle 52 formed at one end of a circular hook 45 having the other end formed into the axis 44 associated with a suitable drive device is circulated in one direction in such a manner as to pass inside the left-hand bundle of hank at a position beneath the left-hand presser bar 46 and lateral to the right-hand presser bar 47 and then outside the right-hand bundle of hank at a position in which the corresponding portion of the bundle of hank is depressed by the presser bar 47. The hook needle 52 passing outside the right-hand bundle of hank is hereinafter described further passes inside the right-hand bundle of hank above the right-hand presser bar 47 and lateral to the left-hand presser bar 46 and then outside the left-hand bundle of hank at a position in which the corresponding portion of the bundle of hank is depressed by the presser bar 46, thereby to establish the condition as illustrated in FIG. 10(e). However, as soon as this condition is established, the hook needle 52 commences to circulate in the opposite direction. As this happens, the hook needle 52 catches the terminating end of the thread T firmly until the hook needle 52 returns back to the original position which is illustrated in FIG. 10(f).

Thus, it will be clearly understood that, by the movement of the hook 45 as hereinbefore described, the both bundles of hank can be connected together by means of the tie-band R which is formed into the shape of FIG. 8. The provision of this tie-band R on the unitary hank is of great use in separating its component bundles with ease.

It is to be noted that further details of the lacing device H and its operation are disclosed in the U.S. Pat. application Ser. No. 826,979. After the lacing operation on the hank is completed, the cutter means is actuated to cut the terminating end of the thread from a cheese at an upper portion above the guide bar and separates the relationship between the feeder and the reel. The tools 49 are arranged for the purpose of putting the both ends of the hank in order and delivering them to the knitter I in the following process.

The knitter I is provided with means for sucking both the starting and terminating ends T' and T" into a guide groove 53 (FIG. 10(h)) and binding them to form a knot automatically in a known manner.

The doffer J, as best shown in FIG. 7 includes a doffer body 55 provided with a drive means 54 drivingly connected with the main drive device C, a trip bar 56 effective to be driven by the drive means to approach to any one of the reeling units for the purpose of operating the operating bar of the movable arms in the reel, a receiving bar 57 effective to approach to the any one of the reeling units together with said trip bar for purpose of receiving a laced hank thereon from the related reel, and a gathering unit 58 as one suitable receptacle for the hank effective to receive the hank from the trip bar and the receiving bar as they are driven by the drive means to approach thereto and remove the hank from the reel to the gathering unit. The doffer of this construction can be operated in the following manner: When any one of the reeling units B
carrying the laced hank with a knot bound by the knotter on its reel is approached to the doffer J, the operating bar 13 of the movable arms 8 in the reel is downwardly pressed by the trip bar 56 to retract a vertically arranged pair of the movable arms 8. Thus, respective ends of the movable arms 8 opposite to the connected ends are inwardly displaced and thus two stays transversely positioned on said ends of the movable arms 8 are collapsed inwardly of the reel, resulting in the hank therein being ready to be released from the reel 2. The hank thus released of tension is then hung on the receiving bar 87 which, in turn, removes it from the reel and delivers it to the gathering unit 58 by means of the drive means. At this time, the movable bar 12 of the thread end retainer G is displaced so as to extend outwardly of the reel in driving connection with the movable arms 8 so that the tie-band is firmly tied. Thus the knot formed adjacent to the tie-band is then pulled upwardly away from the position where the tie-band has been originally located to another position whereby the attendant worker or the user of the hank manufactured by the machine of this invention can easily find where the knot is. In addition, this knot spaced from the tie-band can be easily released by the user.

After the laced hank is removed from any one of the reels 8, the related one of the reels 8 is supplied with another thread from the feeder and this thread is retained by the retainer bar 10, and then past the set plate 33 as it is circulated, resulting in the following reeling operation.

The reeling machine of the present invention comprises the combination of the arrangements as hereinafter fully described whereby a laced hank containing a sufficient amount of thread can be successively fabricated one after another in an automatic manner.

The operational modes of the reeling machine of the present invention will be hereinafter described with reference to FIGS. 10a to 10d:

a. After the starting end of the thread supplied from a desired thread through the guide bar to the reel is retained by the retainer bar 10, the reel rotating motor is driven to rotate the reel while the guide bar 26 is firstly shifted at the second position, thereby to form the first half of a single hank on the left side of the reel.

b. Then, while the reel is rotated by the motor 16, the guide bar is shifted to the right position to form the remaining half of a single hank on the right side of the reel.

c. One revolution before the reel is rotated to the desired number, the guide bar is shifted to the left position to cause the terminating end of the thread from a cheese to be retained by the thread end retainer G, and then the reel is stopped of its rotational movement at the predetermined position about its own axis after the desired number of revolutions.

d. The lacing device is moved close to the reel formed with a finished unitary hank thereon to cause the circular hook 45 to be contacted with a front portion of the hank.

e. The circular hook is revolved in the counterclockwise direction so as to cause the hook needle positioned on the pointed end thereof to hook the starting end of the thread.

f. The circular hook is then reversely revolved in the clockwise direction so as to separate the starting end of the thread from the thread end retainer bar 10 by means of the hook needle and thereby to form a tie-band in an 8-shape sufficient to bind the first half and second half of the hank in a single bundle.

g. The terminating end of the thread from a cheese is cut by the cutting means and then arranged adjacent to the starting end of the thread.

h. The hank thus laced on the reel is delivered to the knotter wherein a knot of the tie-band is formed with the starting end and terminating end of the thread.

i. The reel carrying the knotted hank thereon is associated with the doffer.

j. The trip bar in the doffer is operated with respect to the operating bar of the movable arms in the reel to cause the stays drivingly connected thereto to be collapsed resulting in that the hank is released from tension to come loose, which is then turned and removed by the receiving bar from the reel to the reeling unit when the doffer G. At the same time, the movable bar of the thread end retainer in driving connection with the movable arms is displaced to tighten the tie-band and move the knot formed on the tie-band to a position somewhat apart therefrom.

k. The reel removed of its corresponding laced and knotted hank is again supplied with another thread from same cheese with its thread end holding bar retaining the starting end of the thread through the guide bar, and performs the following operation in such a manner as described in the item a). The finished hanks received by the receiving bar is transferred to the gathered unit which in turn places it to a suitable receptacle.

The whole processes as hereinafter described in the items a) to k) are, in the reeling machine of the present invention, successively performed in an automatic manner while the turntable is rotated one revolution. Furthermore, the hank thus fabricated by the machine of the present invention has a tie-band effective to bind the first half and second half of a single hank with the starting and terminating end of thread of the hank. And the movable bar 11, and the knot formed in the hank is so positioned away from the position wherein the tie-band has been formed that not only the knot can be easily found but also can be easily released without entangling by the user. We have shown and described one embodiment in accordance with the present invention. It is understood that the same is not limited thereto but is susceptible of numerous changes and modifications as known to a person skilled in the art and we, therefore, do not wish to be limited to the details shown and described herein, but intend to cover all such changes and modifications as are encompassed by the scope of the appended claims.

What is claimed is:

1. An automatic reeling machine comprising a reeling unit including a rotatable reel on which a thread can be wound by retaining releasably the starting end of the thread for forming a hank of the thread, a reel rotating means for rotating the reel to wind the thread thereon and a thread feeding means for supplying the thread from a feeder to the reel through a guide bar and a detector for detecting the completion of various stages of the winding operation of the reel and for controlling the operation of said reel rotating means.

2. An automatic reeling machine according to claim 1, characterized in that said guide bar is selectively movable to a plurality of discrete positions with respect to said reel, and means are provided to move said guide bar from one discrete position to another.

3. An automatic reeling machine according to claim 2, characterized in that said detector includes means to measure the number of revolutions that the reel has completed in the winding operation and means to actuate the means to move said guide bar in response to a predetermined number of revolutions of the reel.

4. An automatic reeling machine according to claim 3, characterized in that said reeling unit is mounted adjacent the edge of a rotatable turntable, stationary tripping devices operatively connected to the turntable drive means are positioned adjacent the edge of the turntable for controlling the rotation of said turntable, and said reeling unit includes selectively engageable means for activating said tripping devices to stop and start the turntable.

5. An automatic reeling machine according to claim 4, characterized in that said selectively engageable means includes a detector rod mounted on said reeling unit for vertical movement with respect to said reel, and means for movement of said detector rod being operatively connected to said guide bar for moving said detector rod in response to movement of said guide bar.

6. An automatic reeling machine according to claim 1, characterized in that said reel comprises a plurality of radial
arms extending substantially perpendicularly from the axis of rotation of the reel, the ends of said arms having thread engaging stays extending parallel to said axis of rotation, each of said stays having first portions extending on one side of a plane substantially perpendicular to said axis of rotation and second portions extending on the other side of said plane.

7. An automatic reeling machine according to claim 6, characterized in that said guide bar is movable to first and second positions, whereby the thread is guided for winding on the reel when said guide bar is in said first position and whereby the thread is guided for winding on the respective second portions when said guide bar is in said second position.

8. An automatic reeling machining according to claim 7, characterized in that means are provided to move said guide bar from said first position to said second position, and wherein said means for moving the guide bar is actuated by said detector.

9. An automatic reeling machine according to claim 8, characterized in that said detector includes means to measure the number of revolutions that the reel has completed in the winding operation, and wherein said actuation of the means for moving the guide bar is in response to a predetermined number of revolutions of the reel.

10. An automatic reeling machine according to claim 9, characterized in that said guide bar is moved from said first position to said second position upon one half of the total number of revolutions desired in the winding of a particular hank.

11. An automatic reeling machine according to claim 10, characterized in that said guide bar is movable to a third position, wherein said thread is guided so as to not be in engagement with said stays.

12. An automatic reeling machine according to claim 11, characterized in that said guide bar is moved to said third position upon the completion of the total number of revolutions desired in the winding of a particular hank.

13. An automatic reeling machine according to claim 12, characterized in that said reeling unit is mounted adjacent the edge of a rotatable turntable, stationary tripping devices being disposed adjacent the edge of the turntable for controlling the rotation of said turntable, said reeling unit comprising a detector rod selectively engageable with said tripping devices, and wherein said guide bar is operatively connected to said detector rod for causing the engagement of said detector rod with said tripping devices in response to movement of said guide bar.

14. An automatic reeling machine comprising a reeling unit including a rotatable reel on which a thread can be wound by retaining releasably the starting end of the thread for forming a hank of the thread, a reel rotating means for rotating the reel to wind the thread thereon and a thread feeding means for supplying the thread from a feeder to the reel through a guide bar, and a selectively engageable locking means for locking said reel at a fixed rotational position upon completion of the winding operation.

15. An automatic reeling machine according to claim 6, wherein said locking means is actuated to stop the reel at a fixed position in accordance with a predetermined number or revolutions completed during the winding operation.

16. An automatic reeling machine according to claim 6, wherein said reel rotating means is selectively operable at a high speed and a low speed, said locking means is operable only when said rotating means is operating at the low speed.

17. An automatic reeling machining according to claim 14, wherein said locking means includes a rotary disc drivingly connected with the reel and selectively engageable detent means for engaging said disc.

18. An automatic reeling machine according to claim 17, wherein said selectively engageable detent means is mounted on a pivotal lever and wherein the periphery of said disc includes a slot for engagement with said detent means.

19. An automatic reeling machine comprising a reeling unit including a rotatable reel on which a thread can be wound by retaining releasably the starting end of the thread for forming a hank of the thread, a reel rotating means for rotating the reel to wind the thread thereon and a thread feeding means for supplying the thread from a feeder to the reel through a guide bar, and a thread end retainer for retaining the terminating portion of the thread separately from the bulk of the thread being wound.

20. An automatic reeling machine according to claim 19, wherein said thread end retainer is movable to a position adjacent the bulk of the thread being wound.

21. An automatic reeling machine according to claim 19, characterized in that said reeling comprises a plurality of radial arms extending substantially perpendicularly from the axis of rotation of the reel, the ends of said arms having thread engaging stays extending parallel to said axis of rotation, said stays forming with said yarn a polygon shaped yarn winding surrounding the axis of rotation, said thread end retainer including a first and second member having respective thread engaging portions, the thread engaging portion of said first member being fixed relative to said axis of rotation and being disposed entirely within said polygon shaped yarn winding, the thread engaging portion of said second member being selectively movable from a position within said polygon shaped winding to a position without said polygon shaped winding.

22. An automatic reeling machine comprising a reeling unit including a rotatable reel on which a thread can be wound by retaining releasably the starting end of the thread for forming a hank of the thread, a reel rotating means for rotating the reel to wind the thread thereon and a thread feeding means for supplying the thread from a feeder to the reel through a guide bar, and a lacing device for forming a tie-band with the thread being wound to bind said hank in a single bundle after completion of the winding operation on the reel.

23. An automatic reeling machine according to claim 22, wherein said lacing device is drivingly connected with a locking means effective to lock the reel at a fixed position with respect to the axis of rotation of the reel upon completion of the winding operation.

24. An automatic reeling machine according to claim 22, characterized in that the lacing device includes circular needle means, one portion of said needle means being positionable to engage the starting end of the thread being wound, and means for rotating said circular means for forming the tie-band in a "figure-eight" shape through the yarn hank.

25. An automatic reeling machine according to claim 22, characterized in that the said reel comprises a plurality of radial arms extending substantially perpendicularly from the axis of rotation of the reel, the ends of said arms having thread engaging stays extending parallel to said axis of rotation, each of said stays having first portions extending on one side of a plane substantially perpendicularly to said axis of rotation and second portions extending on the other side of said plane, said guide bar being movable to first and second positions for winding the thread on the respective first portion of said stays when said guide bar is in said first position and for winding the thread on the respective second portion of said stays when said guide bar is in said second position, said reel unit being operable to wind one half of a particular hank on the respective first portion and one half on the respective second portion with a spacing therebetween, and wherein said lacing device includes a circular needle engageable in said spacing for forming the tie-band in a "figure-eight" configuration about the respective halves of the hank and thus the spacing between said hank.

26. An automatic reeling machine comprising a reeling unit including a rotatable reel on which a thread can be wound by retaining releasably the starting end of the thread for forming a hank of the thread, a reel rotating means for rotating the reel to wind the thread thereon, a thread feeding means for supplying the thread from a feeder to the reel through a guide bar, said reel including a plurality of radial arms, thread engaging
stays extending perpendicularly from the ends of said radial arms, at least one of said radial arms being selectively collapsible in the radial direction for loosening the thread wound on said reel, a doffer for removing said hank from the reel, and said doffer includes means for selectively collapsing said at least one radial arm to loosen the thread and thereby aid in removing the thread from the reel.

27. An automatic reeling machine comprising a reeling unit including a rotatable reel on which a thread can be wound by retaining releasable the starting end of the thread for forming a hank of the thread, a reel rotating means for rotating the reel to wind the thread thereon and a thread feeding means for supplying the thread from a feeder to the reel through a guide bar, a turntable for mounting said reeling unit to rotate in a circular path around a fixed axis of said turntable, and a main drive device for rotating said turntable.

28. An automatic reeling machine according to claim 27, wherein a plurality of said reeling units, each including a rotatable reel, a reel rotating means and a thread feeding means, are arranged on the turntable in the turret form.

29. An automatic reeling machine according to claim 28, characterized in that a lacing device and a doffer are arranged for selective engagement with each of said reeling units, said lacing device and said doffer being movable in the radial direction with respect to the fixed axis of the turntable, said lacing device and said doffer being spaced from one another and being substantially immovable in the circumferential direction about the fixed axis of the turntable, said lacing device being operative to form a tie-band to bind the hank formed on the reel in a single bundle after completion of the winding operation on a particular reeling unit and said doffer being operative to remove the hank from a particular reeling unit after the tie-band has been formed.

30. An automatic reeling machine according to claim 29, characterized in that the lacing device is arranged to form the tie-band using the thread ends from the thread being wound whereby the finished hank consists of a single unbroken thread.

31. An automatic reeling machine according to claim 29, characterized in that the turntable is intermittently rotatable for precisely positioning the respective reeling units with respect to said respective lacing device and doffer.

32. An automatic reeling machine according to claim 31, characterized in that a knitter is arranged between said lacing device and said doffer for tying a knot with the two ends of the wound thread, said knot being formed adjacent the tie-band.

33. An automatic reeling machine comprising an intermittently rotatable turntable having a plurality of mounting arms radially extending therefrom, said turntable being rotatable about a shaft having one end rigidly mounted with said turntable and the other end drivingly associated with a main drive means, wherein a reeling unit is mounted on the end of each of said mounting arms; and wherein each said reeling unit comprises a reel, a reel rotating means, a feeder for supplying thread from a cheese or bobbin mounted on said reeling unit to said reel, a detector including a plurality of electromagnetic devices and a detector switch, a locking means for stopping the reel at a predetermined position about its axis of rotation, a thread end retainer for moving a knot on a tie-band formed with the starting and terminating ends of the thread from a position adjacent the tie-band to another position apart from said tie-band; a set-off device operatively engageable with respective detector switches including a set device and an off device for controlling the reel rotating means of the reeling units; a lacing device positioned adjacent the turntable and fixed circumferentially with respect to said turntable, said lacing device including means for forming a tie-band with a starting and terminating ends of the thread, said tie-band forming a unitary hank from two bundles of hank formed during the winding operation; a knitter for binding said tie-band positioned adjacent the lacing device; and a doffer for removing and collecting each laced and knotted unitary hank from the respective reels.
Title page, add the following additional application priority data:

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Signed and sealed this 21st day of November 1972.

(SEAL)
Attest:
EDWARD M. FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCALK
Commissioner of Patents