United States Patent [19]

Miller

[11] **3,813,020**

[45] **May 28, 1974**

[54] **YARN ASPIRATOR**

[75] Inventor: **Harry B. Miller,** Hopedale, Mass.

[73] Assignee: **Industrie-Werke Karlsruhe Aktiengesellschaft,** Karlsruhe, Germany

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[21] Appl. No.: **364,107**

[52] **U.S. Cl.** **226/97**

[51] **Int. Cl.** **B65h 17/32**

[58] **Field of Search** 226/7, 97; 28/1.4

[56] **References Cited**

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Primary Examiner—Richard A. Schacher

Attorney, Agent, or Firm—Michael S. Striker

[57] **ABSTRACT**

A winder for yarn and the like, having the automatic yarn transfer system of the present invention, includes a drive roll and at least two rotatable chucks each of which is adapted to carry a bobbin tube and is movable into and out of driven engagement with the drive roll. A traversing arrangement traverses a running yarn which is being wound onto one of the chucks, so as to form a yarn package on the latter. A transfer arrangement effects automatic transfer of the running yarn from the one chuck, upon forming of the yarn package thereon, to the other of the chucks. When the yarn package has been formed on the other chuck the running yarn is then automatically transferred again to the first-mentioned chuck.

8 Claims, 28 Drawing Figures

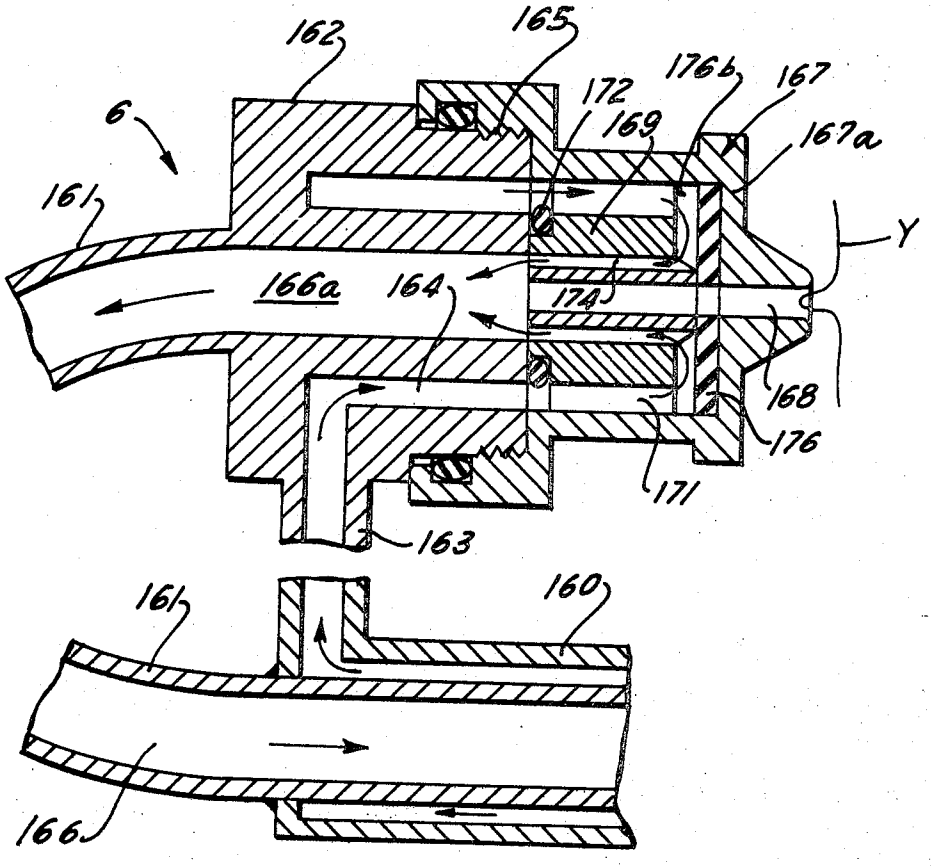


FIG. 1

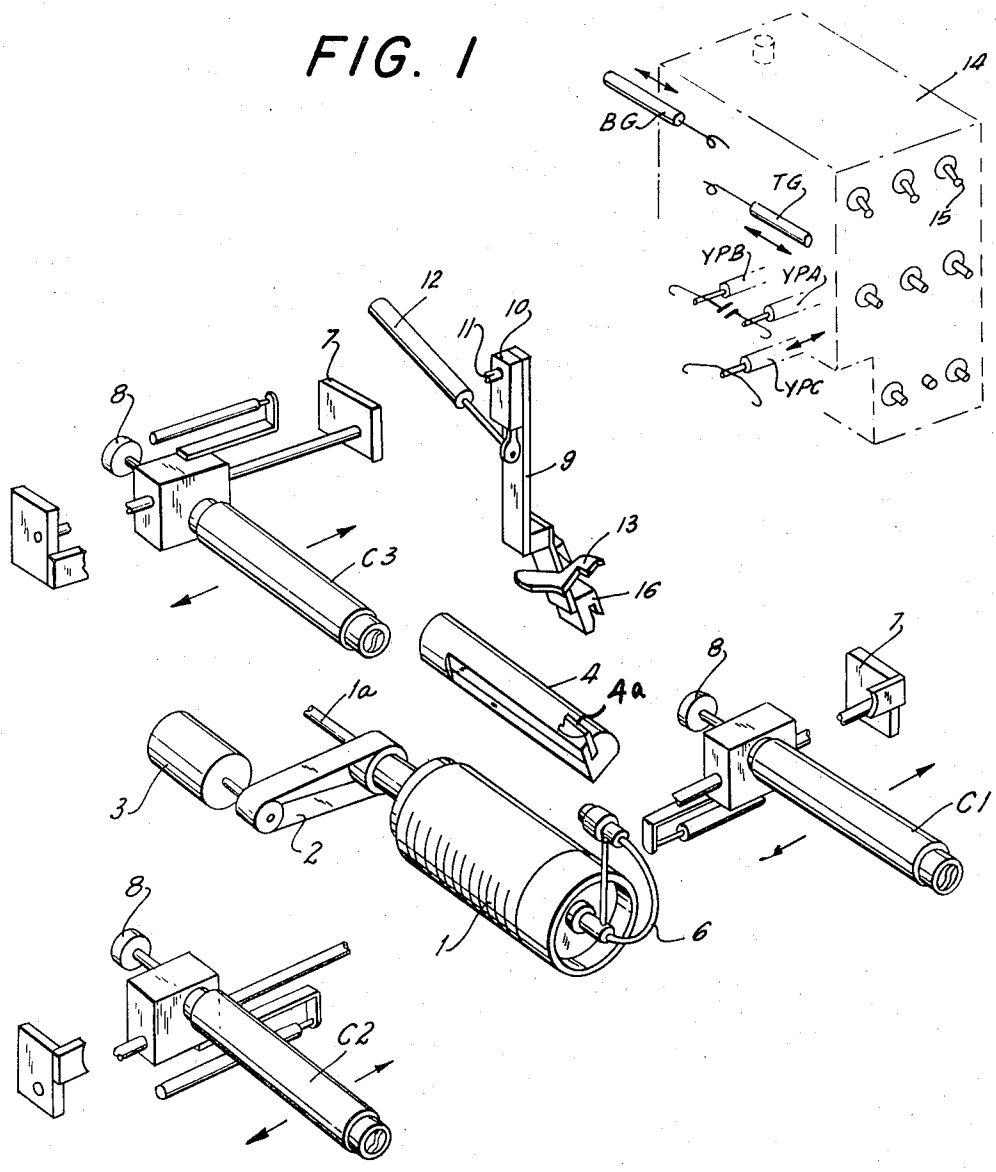
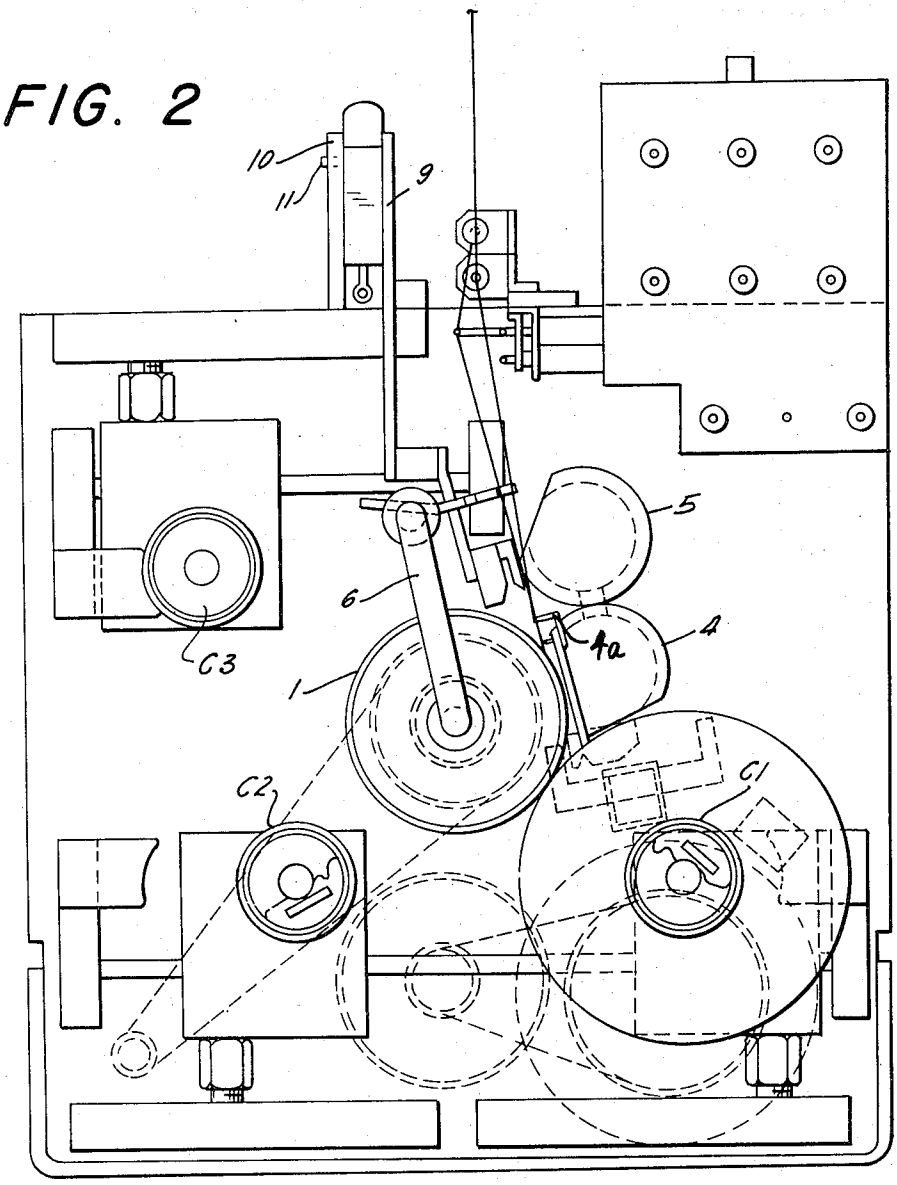


FIG. 2



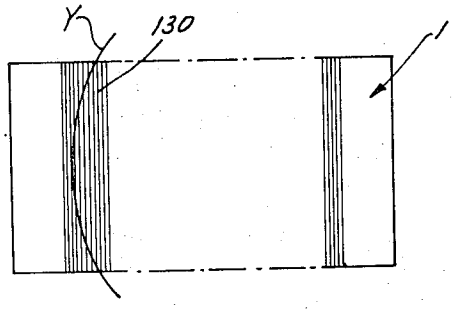


FIG. 13

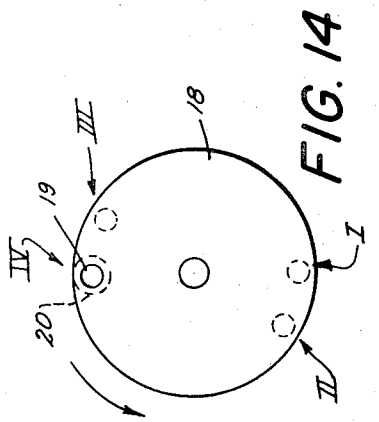

III
18
19
IV
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III

FIG. 14

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FIG. 3

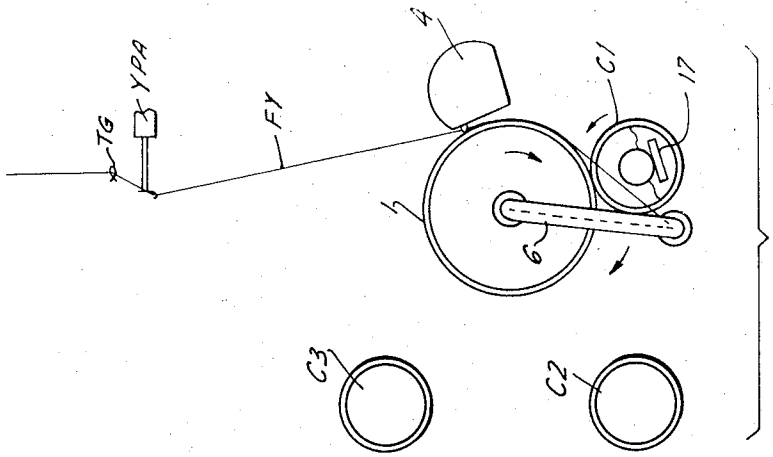


FIG. 6

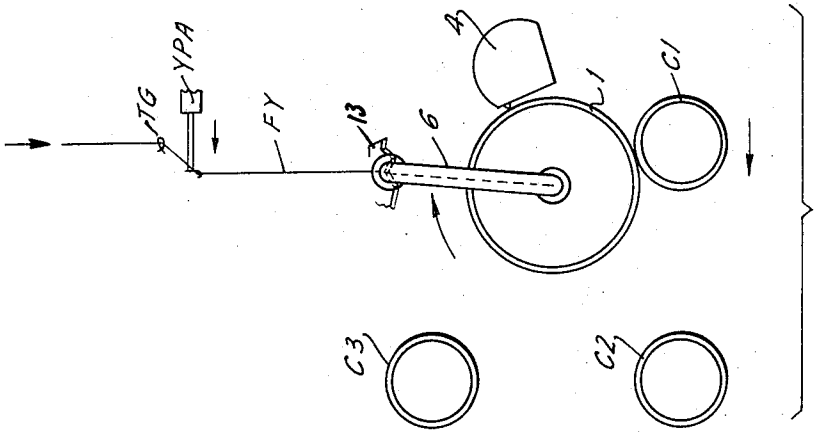


FIG. 5

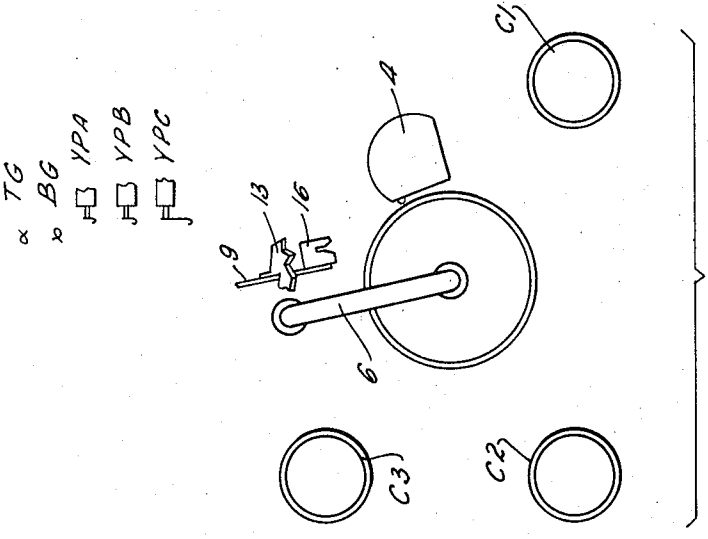


FIG. 4

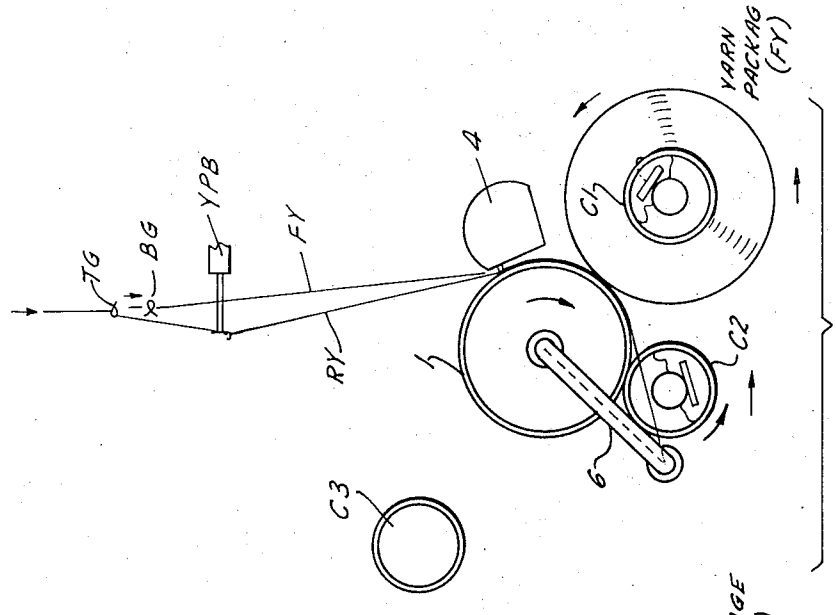


FIG. 9

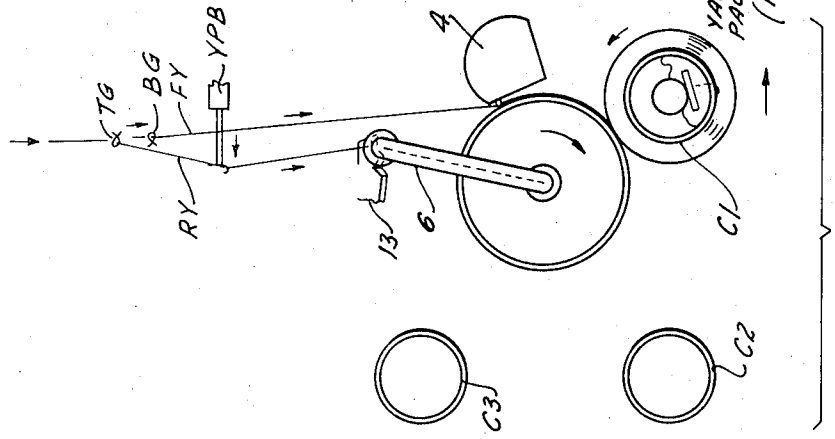


FIG. 8

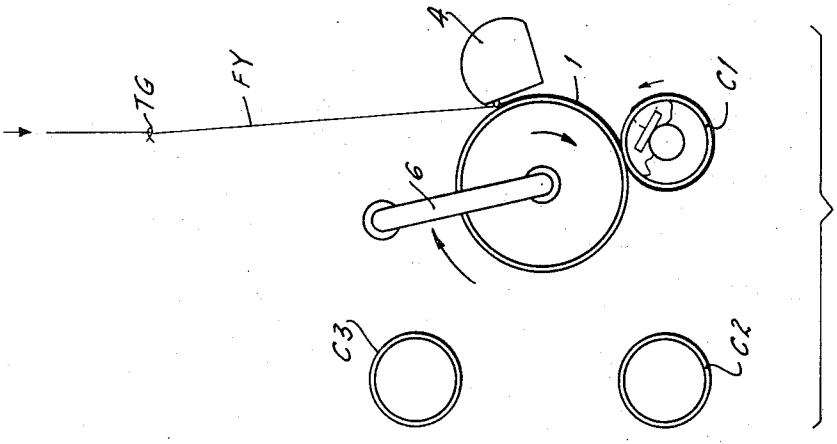


FIG. 7

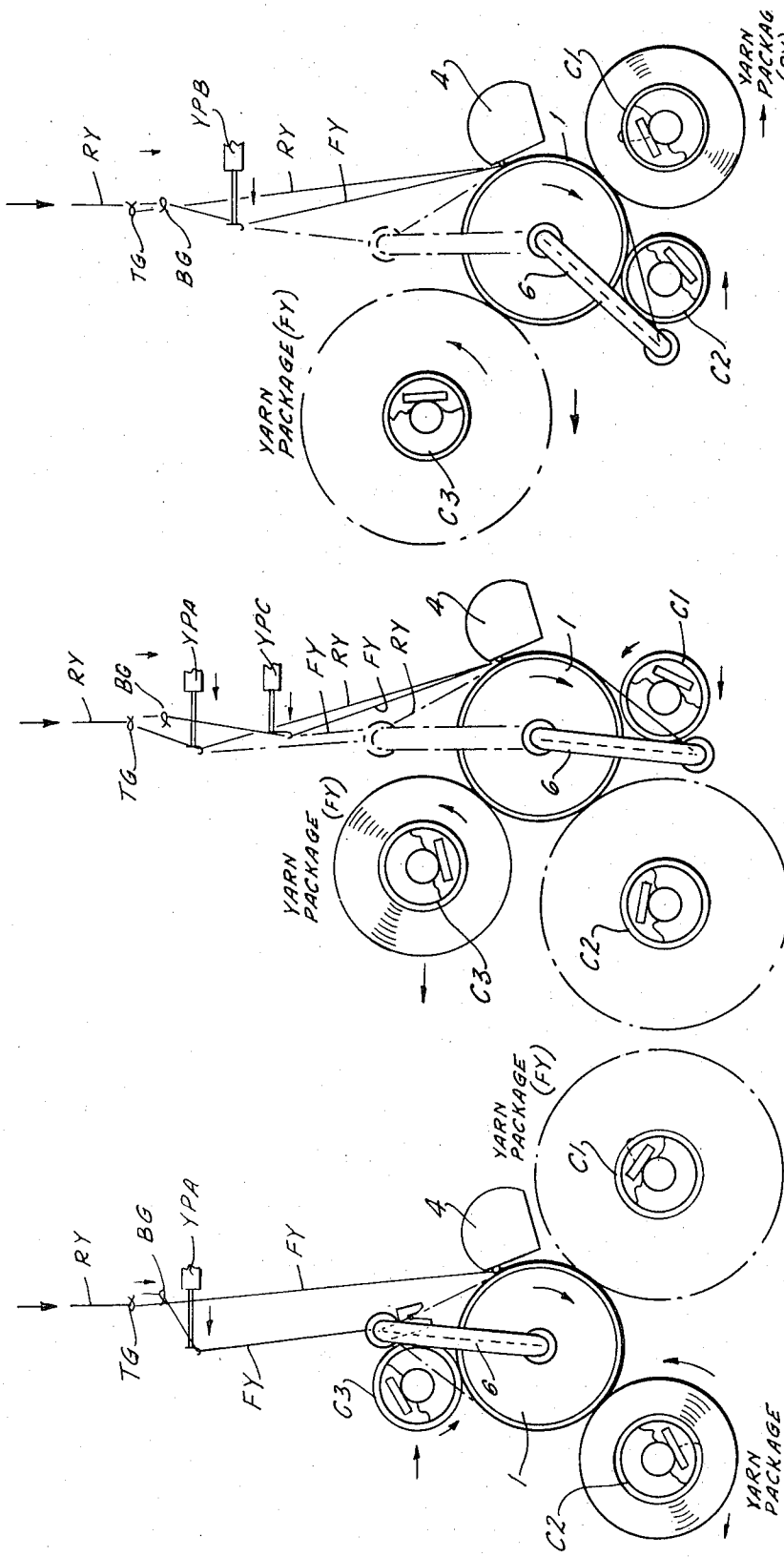


FIG. 10

FIG. 11

FIG. 12

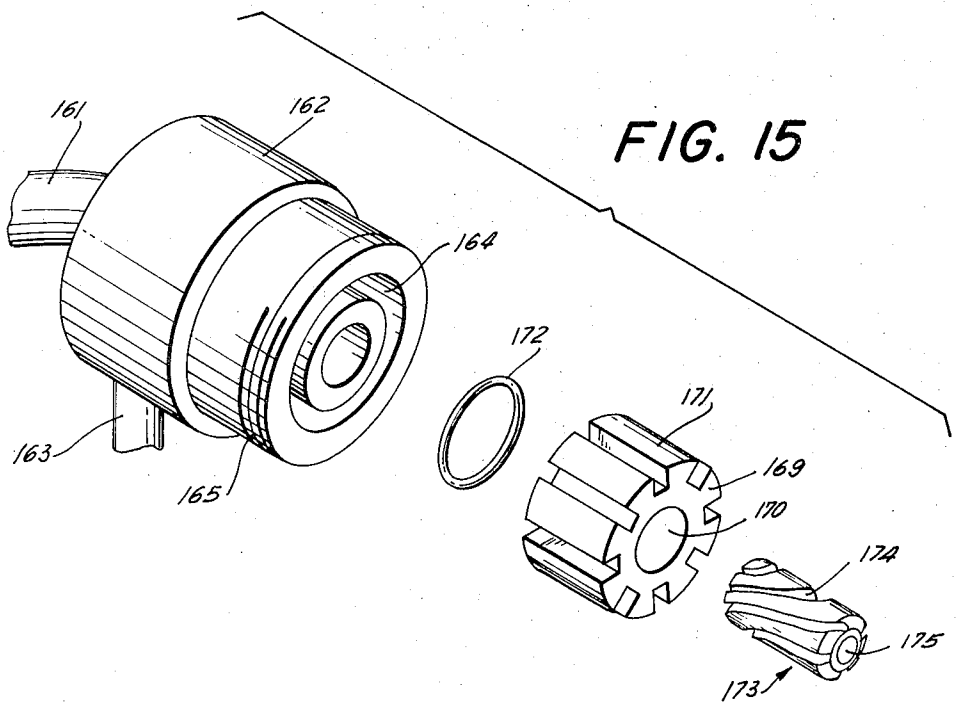

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FIG. 15

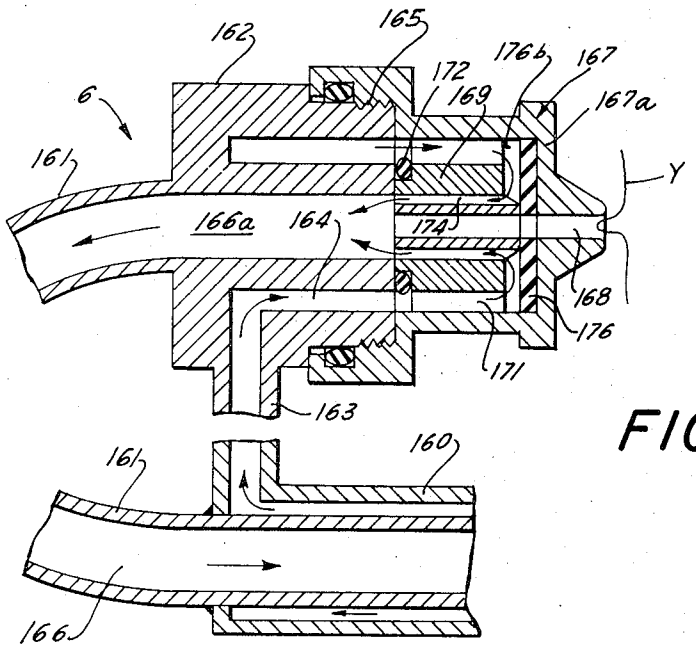

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Y
166a
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FIG. 16

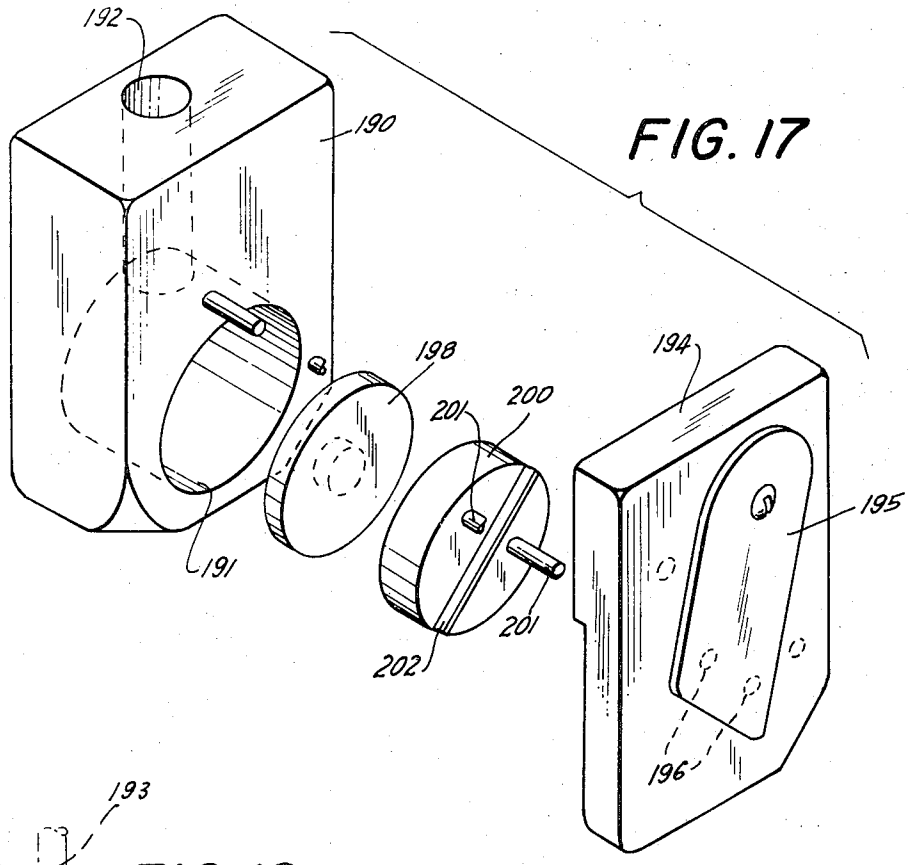


FIG. 17

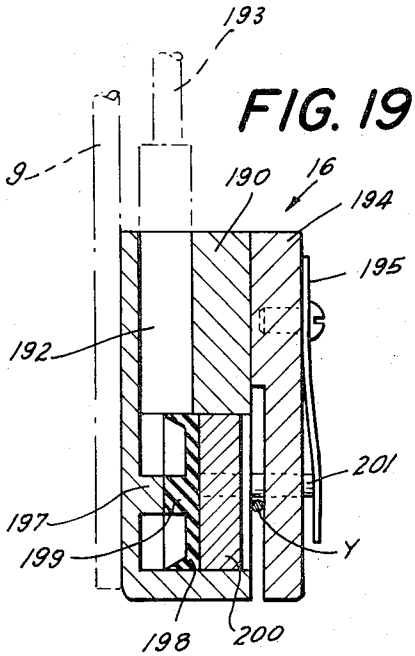


FIG. 19

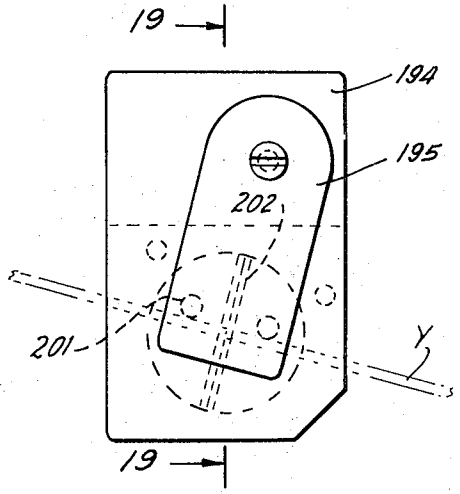
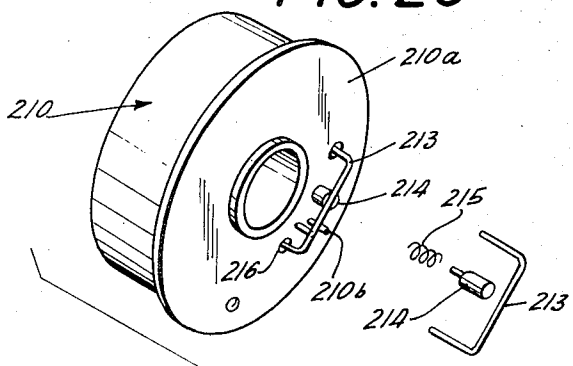


FIG. 18

FIG. 20



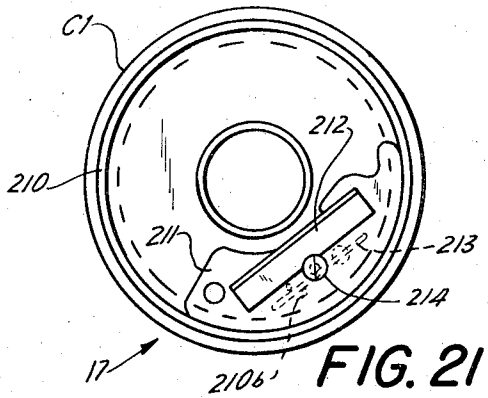
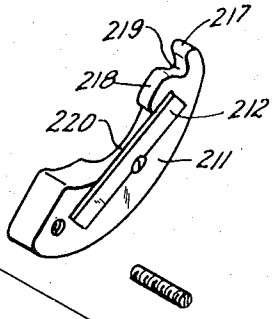


FIG. 21



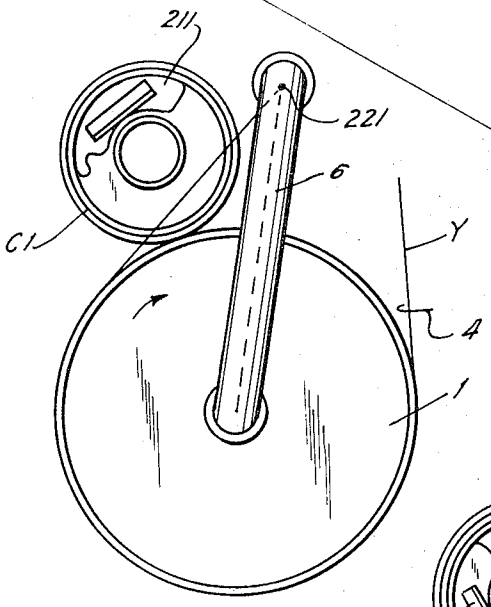


FIG. 22

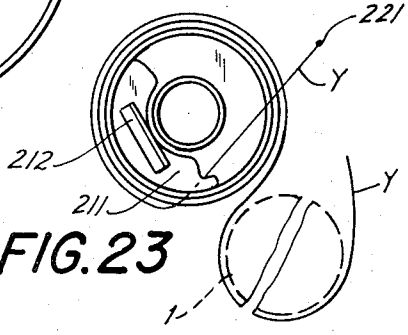


FIG. 23

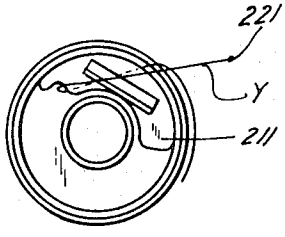


FIG. 24

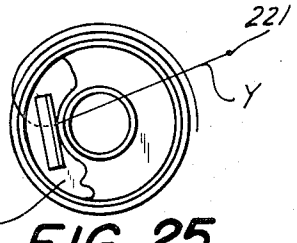


FIG. 25

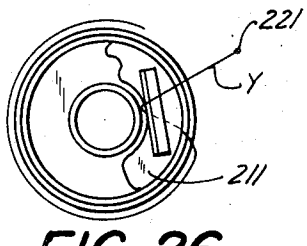


FIG. 26

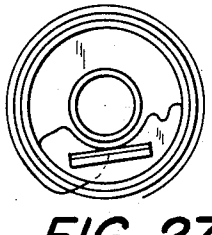


FIG. 27

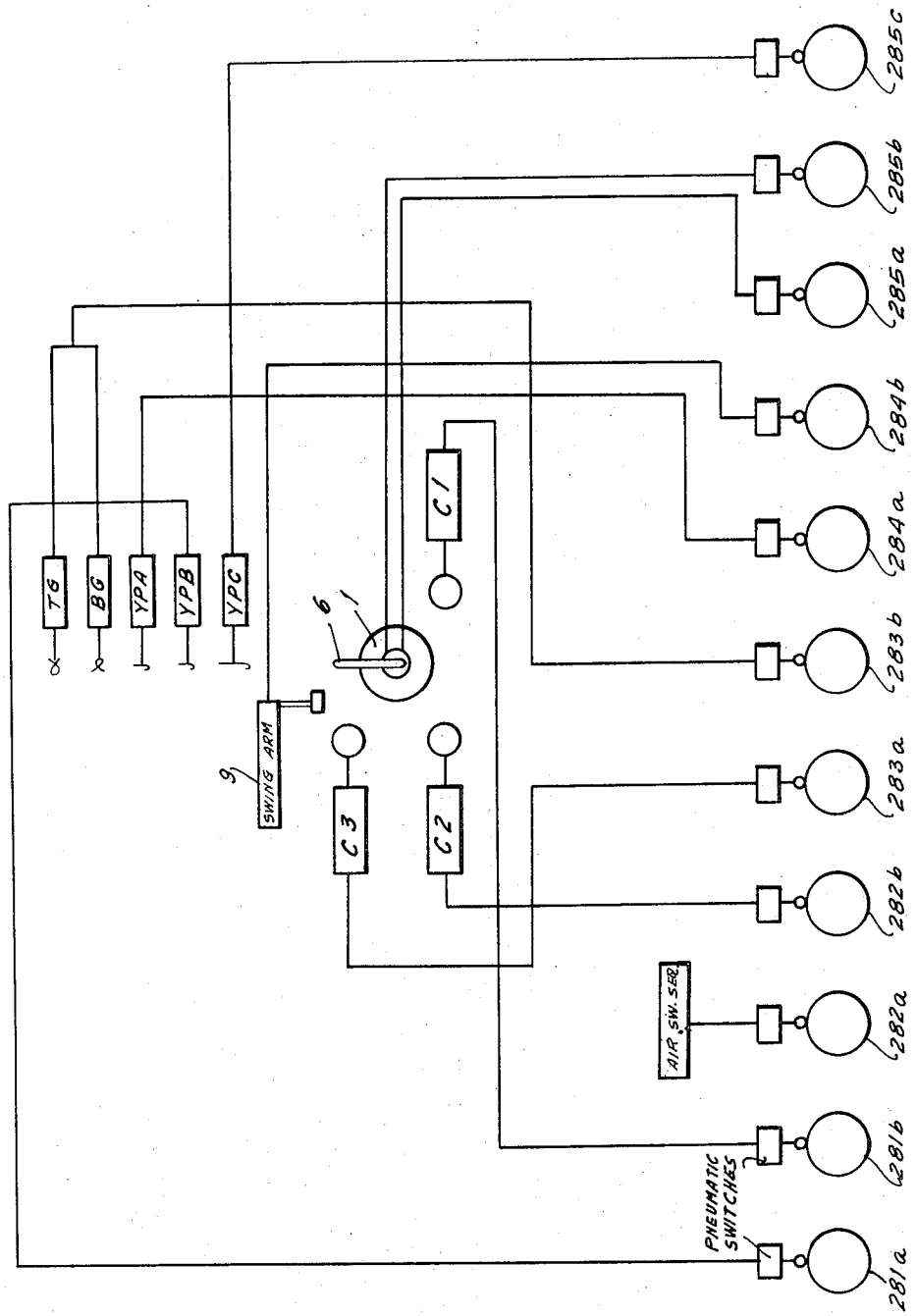

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281b
281a
PNEUMATIC SWITCHES
AIR SW. SEE
TG
BG
YPA
YPB
YPC
C1
C2
C3
SWING ARM
6
1
9

FIG. 28

YARN ASPIRATOR

BACKGROUND OF THE INVENTION

The present invention relates generally to an automatic yarn transfer system, and more particularly to an automatic yarn transfer system in a winder for yarn and the like.

Yarn winding machines or winders are used by all yarn producers, usually in batteries of dozens or even hundreds of such winding machines. These machines are utilized to wind yarn onto a bobbin tube which is mounted on a rotatable chuck, in order to form a yarn package on the bobbin tube. The thread or yarn is usually supplied directly from a producer to the winding apparatus. When a yarn package on the winding apparatus has reached full size, that is when the yarn package has been completed, the incoming "running" yarn must be cut, the bobbin tube with the package removed, a new bobbin tube put in place on the chuck, and the winder must be rethreaded with the running yarn so that the yarn can begin to form a new package on the new bobbin tube. The package size, shape, weight or the like usually vary widely, depending upon the requirements of a particular order.

Textile mills using such winders usually operate without interruptions, except for those caused by a breakdown. This means that thousands of workers are required to perform the necessary operations 24 hours a day, 7 days a week. In part, the number of workers required is so high because each winding machine requires the individual attention of an operator every time a bobbin tube must be changed, that is every time a package has been completed and a new bobbin tube must be put in place on the chuck and the winder rethreaded. Evidently, this is very expensive in terms of labor cost, especially if small packages must be produced, inasmuch as the heavier the yarn and the smaller the packages the more often the changing of bobbin tubes and re-threading of the winder must be performed.

It is known to provide winding apparatus or winders, as they will hereafter be called, with a single chuck or two chucks. If the winder is of the type having a single chuck, then the bobbin-tube changing and rethreading operation is particularly expensive in terms of labor costs, because the threading-up operation of a single-chuck winder involves the following steps:

a. The incoming "running" yarn must be drawn into a string-up or thread-up aspirator and severed from the completed package. This is necessary because the yarn runs continuously and does not stop during the time required for removing the completed package and replacing it with a new bobbin tube.

b. The chuck on which the completed package is produced must be stopped and the bobbin tube released from the chuck.

c. Thereupon, the bobbin tube carrying the completed package is removed from the chuck.

d. An empty bobbin tube is then placed onto the chuck and clamped in place.

e. Now the chuck is started up again and its take-up speed synchronized with the speed of the running yarn.

f. Finally, the yarn is manually brought to the chuck, threaded-up (connected with the chuck) and winding

of a new package on the empty bobbin tube is begun.

During the time elapsed from the moment the running yarn has been drawn into the aspirator and cut, until the moment winding of a new package is begun, running yarn has been drawn into the aspirator and ejected from the same into a waste bin, so that such yarn is lost and represents an effective loss of material.

In a two-chuck winder the operation is analogous to the one just described, except that the period for which yarn is wasted can be somewhat reduced in that an empty bobbin tube can already be in stand-by position on the second chuck which can be ready in receive the running yarn shortly after it has been severed from the completed package. The completed package is then removed from its chuck while a new package is being formed on the second chuck. However, the transfer is still manual and requires the individual attention of an operator.

Considering the numbers of winders involved in such operations, and the numbers of man-hours which must be spent in the manual re-stringing of winders every time a yarn package has been completed, and further taking into account the amount of yarn which is being lost during the time which elapses between completion of one package and starting-up of the next package, it is evident that further improvements in the state of the art are not only desirable but indeed of the highest economic significance. However, to my knowledge these improvements have not heretofore been forthcoming in this field.

SUMMARY OF THE INVENTION

It is, accordingly, a general object of the present invention to provide such improvements as outlined above.

More particularly it is an object of the present invention to provide a novel automatic yarn transfer system for use in winders for yarn and the like.

Another object of the invention is to provide such a novel yarn transfer system for use with yarn winders having two, three or more chucks.

An additional object of the invention is to provide such a yarn transfer system which permits the automatic formation of a transfer tail on each yarn package.

Another object of the invention is to provide a novel yarn transfer system in accordance with the present invention which makes it possible for a single winder to simultaneously operate with one or more running threads or yarns.

Still a further object of the invention is to provide a system of the type in question which makes it possible to produce yarn packages of uniform yarn length and which, when yarn is subsequently withdrawn from them will deliver the yarn uniformly and without plucks.

A further object of the invention is to provide such a yarn transfer system wherein the crossing and entangling of the running yarn is avoided, even though two or more yarns may be running simultaneously to the same winder and be automatically transferred from chuck to chuck upon adhesion of the respective yarn packages.

Another object of the invention is to provide an improved aspirator for use in conjunction which the novel

automatic yarn transfer system of the present invention.

An additional object of the invention is to provide improved cutters for severing the yarn prior to transfer from a completed package to a new chuck, and for severing yarn which runs through the aspirator and which is being picked up by a new chuck for starting of a new yarn package.

In keeping with these objects, and with others which will become apparent hereafter, one feature of the invention resides, for use in a winder for yarn and the like, in a yarn aspirator which comprises an aspirating tube having an inlet for air and yarn, and an element which imposes upon the aspirated air and yarn a swirling movement so that the aspirated yarn can be readily made to pass through a 180° turn.

Th novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however both as to its construction and its method of operation, together understood from the following description of specific embodiments when read in connection with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a exploded chematic view, illustrating those components of a winder provided with my automatic yarn transfer system which are necessary for an understanding of the invention;

FIG. 2 is a somewhat disgrammatic front-elevational view of the winder in FIG. 1;

FIG. 3 is a diagrammatic side-elevational view of the winder shown in FIG. 2;

FIGS. 4–12 are respective diagrammatic front views illustrating yarn-transfer sequences in the novel winder;

FIG. 13 is a top-plan view of the drive roll of the novel winder;

FIG. 14 is an elevational view on line 14—14 of FIG. 3, looking in the direction of the indicated arrows;

FIG. 15 is a fragmentary exploded detail view illustrating details of various components of the aspirator of the winder in FIGS. 1–3;

FIG. 16 is a fragmentary vertical section through the aspirator of FIGS. 1–3 and 15, with the components of FIG. 15 shown in assembled condition;

FIG. 17 is an exploded detail view illustrating one type of yarn cutter employed in the novel winder;

FIG. 18 is a front-elevational view of FIG. 17;

FIG. 19 is a section taken on line 19—19 of FIG. 18;

FIG. 20 is an exploded view illustrating details of the components of another type of yarn cutter employed in the novel winder;

FIG. 21 is a front elevation of the winder shown in FIG. 20;

FIGS. 22–27 are respective diagrammatic detail views showing a complete operational sequence of the cutter in FIGS. 20 and 21; and

FIG. 28 is a pneumatic schematic illustrating an air-logic control system for controlling the functions of the novel winder.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A winder employing the transfer system according to the present invention should advantageously be of the surface drive type, that is it should have a drive roll which drives the rotatable chucks of the winder in response to contact of these chucks with the circumferential surface of the drive roll. The drive roll should have a hollow stationary shaft upon which it rotates and through which the aspirator can discharge aspirator running yarn, in the manner to be described later. Two or more chucks should be provided, and if the winder has three chucks it is advantageous if two of them contact the drive roll below a horizontal plane passing through its axis of rotation and the third chuck contacts it above this horizontal plane and to one side of a vertical plane passing through the axis of rotation. A traverse arrangement for traversing the running yarn should be provided at the opposite side of the vertical plane, opposite the third chuck, and the chucks should move horizontally towards and away from the drive roll, that is into and out of engagement therewith. With the above-general comments in mind, there will now be provided a description of the basic machine components of the novel winder provided with the automatic yarn transfer system.

THE BASIC MACHINE COMPONENTS

Referring to FIGS. 1–3, 13 and 14 it will be seen that in these Figures I have illustrated details of the basic machine components of the novel winder. Reference numeral 1 identifies a drive roll which is of the surface drive type and which is provided, as shown in FIG. 13, with a plurality of circumferentially extending shallow grooves or flutes 130 in its outer circumferential surface. The purpose of these flutes 130 is to assure that the yarn Y running in contact with the outer circumferential surface of the drive roll 1 and onto a respective one of the chucks which are to be described, will be somewhat retarded in the manner illustrated in FIG. 13. The drive roll rotates about a stationary hollow axis and is driven by a belt 2 which receives motion from an electromotor 3. At one side of a vertical plane passing through the axis of rotation of the drive roll 1 (see FIG. 2) there is provided a conventional traverse guide 4 of the type used in most winders, which serves to traverse the running yarn axially of a respective chuck so as to wind a uniform package thereon. Reference numeral 5 identifies a support on which the transverse guide 4, whose construction and operation are conventional and therefore need not be described in detail, is mounted.

To prevent the yarn from slipping off the package onto which it is being wound when the yarn is displaced forwardly (up from the plane of FIG. 2, and to the left in FIG. 3), the traverse guide is provided at its forward end with a yarn-intercepting portion 4a whose operation will be readily evident from a perusal of FIGS. 2 and 3.

A yarn aspirator 6, which will be described in detail with reference to FIGS. 15 and 16, is mounted on the drive roll so as to communicate with the hollow stationary shaft of the latter. This shaft, incidentally, is identified with reference numeral 1a and extends to the rear of the winder as shown in FIG. 3. This makes it possible for waste yarn that is being discharged via the aspirator 6 and the shaft 1a, to be collected in appropriately placed bins or receptacles located at the rear of the winder. It is conventional practice to discharge such waste yarn into receptacles located at the front of the machine where they of course hinder the movements of

the operator — who must service not one but several such winders and should therefore be able to move freely — and constitute a definite hazard. In addition, there is usually not much space available in front of these winders, especially when they are installed in form of batteries composed of many winders. This problem is overcome by the present invention because a receptacle located behind the winder is out of the way and does not present a hazard to the operator who usually is required to move only in front of the winder.

In the illustrated embodiment the winder is provided with three chucks C1, C2 and C3 each of which is provided with a guide 7 permitting it to move as indicated by the double-headed arrows, namely horizontally towards and away from the drive roll 1. Two of the chucks, namely C1 and C2, are located so as to engage the drive roll 1 below a horizontal plane passing through the axis of rotation of the drive roll, and the chuck C3 is located so as to engage drive roll 1 above the chuck C2 namely to the left of a vertical plane passing through the axis of rotation of the drive roll and opposite the traverse guide 4. Reference numeral 8 diagrammatically indicate drives for the chucks C1, C2 and C3 so that the chucks can be moved along the guides 7. The chucks are advantageously pneumatically operated so as to clampingly engage a bobbin tube (not shown) which is slipped over them and on which the respective yarn package is to be wound.

The swing arm 9, whose operation and purpose will be described later, is mounted on a support 10 for pivotal movement about a pivot axis 11. This pivotal movement is transmitted to the swing arm 9 and the support 10 via a pneumatically operated cylinder and piston unit 12. In the region of its lower end the swing arm 9 carries a shaped yarn guide plate 13 and a yarn cutter 16, the details of which latter will be described with reference to FIGS. 17–19.

The swing arm 9 could, incidentally, be replaced by another component which performs the same function concerning the movement of the yarn. Thus, a cylinder and piston unit could be used, having the plate 13 and the cutter 16 mounted on it. This would require mere straight-line extension and retraction rather than a pivoting movement and would save space.

Reference numeral 14 designates a control cabinet provided with a plurality of function-controlling switches 15, for instance taggle switches.

The free end of each of the chucks C1, C2 and C3 carries a further yarn cutter 17 which serves not only for cutting but also for previously picking up the yarn which is being transferred to the respective chuck. Details of the cutter 17 will be described later with reference to FIGS. 20–27.

The aspirator 6 is turnable in clockwise direction about the hollow stationary axis of the drive roll 1, as will be described subsequently, and can be arrested at several predetermined positions. For this purpose the axis 1a carries a registration plate 8 which rotates with it and which is provided with a plurality of circumferentially spaced holes 19. A sgot pin 20 can be advanced into, and retracted from the respective holes 19 by a pneumatic cylinder 21 which is mounted on a fixed component of the winder. Thus, depending upon the particular hole 19 of the plate 18 into which the shot pin 20 enters, the plate 18 and thereby the aspirator 6 can be arrested at predetermined angular positions which are designated with reference characters I, II, III and IV, respectively, in FIG. 14. The direction of rotation of the plate 18 is indicated by the arrow associated with it in FIG. 14.

Mounted in the illustrated embodiment on the control cabinet 14 of FIG. 1 are various yarn guides and pushers. These are designated as top guide TG, bottom guide BG, yarn pusher YPA, yarn pusher YPB, and yarn pusher YPC. Each of the guides and pushers is provided with a pneumatically operated cylinder and piston unit which effects movement of the respective guide or pusher in the direction indicated by the respective double-headed arrows.

The top guides and bottom guides TG and BG each comprise the illustrated pigtail yarn guides and it is their purpose to position the two running yarns for pickup by yarn guides, which are attached to the yarn pushers YPA and YPB, at transfer time. The guides TG and BG operate twice every six transfer cycles, namely on the first and on the fourth transfer cycle. The yarn pushers YPA and YPB serve to pick up the respective running yarns and to push them out of engagement with the traverse guide 4 towards the swing arm 9, in readiness for pickup by the guide plate 13 of the latter. This pickup occurs as the swing arm 9 moves forward (towards the left in FIG. 3) and the cylinders associated with the pushers YPA and YPB retract the same before the swing arm moves back to its normal broken-line position in FIG. 3. The pusher YPA operates on the first, third, fourth and sixth transfer cycles and the pusher YPB operates on the second and fifth cycle. The yarn pusher YPC serves to push both of the running yarns out of the traverse guide 4 simultaneously. It will operate to do so at the same time as the pusher YPA, namely on the first, seventh, 13th, etc. transfer cycles. The pusher YPC retracts immediately after one of the running yarn has been drawn into the aspirator 6, thus allowing the other running yarn to move back into engagement with the traverse guide 4. The purpose of the pusher YPC is to eliminate crossed and entangled yarns during transfer operations.

The operation of the automatic yarn transfer system will now be described with reference to the sequence illustrated in FIGS. 4–12.

OPERATION OF THE YARN TRANSFER SYSTEM

FIGS. 4–12 illustrate one operational sequence of the novel winder, and the following description should be taken in conjunction with these Figures as well as with FIG. 28.

When the first yarn is to be strung up in the first operating cycle, which has been designated as the front yarn FY, it is passed through the pigtail associated with the top guide TG. By means of the switches 15 of the control cabinet 14 the winder is now activated and the cylinder 21 withdraws the shot pin 20 from the hole 19 of position III. At this time the cam switch 281*b* (see FIG. 28) is lifted, causing the chuck C1 to move into engagement with the drive roll 1. Just afterwards the cam switch 284*b* is lifted resulting in the yarn pushers YPA and YPC being extended (towards the left in FIG. 1) and at the same time the swing arm 9 moves forwardly to the full-line position shown in FIG. 3. It should be noted that although the yarn pushers YPA and YPB are each controlled by its own cam switch 284*a* and 285*c*, respectively, these cam switches are interconnected with the switch 284*b* which operates the swing arm 9

so that it is the operation of the latter which controls the timing and movement of the yarn pushers YPA and YPC. A pneumatic delay is built into the operation of the swing arm **9** so that the latter moves to the full-line position of FIG. **3** only after the yarn pushers YPA and YPC have been extended.

As these operations have been proceeding, the plate **18** has been rotating and the shot pin **20**, which is permanently urged into engagement with the facing surface of the plate **18**, now drops into the hole **19** corresponding to the transfer position IV; at the same time the shot pin delay cam switch **285***a* drops, starting a pneumatic delay which allows the shot pin **20** to hold the mechanism in this position for a preset period of time. When the swing arm **9** reaches its full line position of FIG. **3** the yarn cutter **16** on the swing arm is operated. This can for instance be effected by permitting a magnetically operated reed switch to activate a solenoid which permits the flow of air to the cutter **16.** Since at this time there is no yarn going through the cutter, the sequence thus far referring only to a string-up operation. there will of course be no actual cutting taking place. The flow of air admitted to the cutter **16** also operates a valve which causes the cylinder of the yarn pusher YPC to retract. At the end of the predetermined delay period the shot pin **20** is retracted from the hole corresponding to the transfer position IV and the plate **18** now rotates until the shot pin enters into the hole corresponding to position I. At this time the free end or open end of the aspirator **6,** into which the front yarn FY has been passing, is located adjacent chuck **C1.** At the same time as the shot pin **20** enters position I, cam switch **285***a* drops and activates the hold sequence while cam switch **284***b* is released and allows yarn pusher YPA to retract, followed after a pneumatic delay by retraction swing arm **9** to the broken-line position of FIG. **3.** This return movement of the swing arm **9** permits the front yarn FY to recede from the plane of the drawing (see FIG. **6**) so that it comes into range of and is engaged by the pick-up and cutter device **17** on chuck C1; this device picks up the yarn from the aspirator **6,** forms a yarn transfer tail and at the same time severs the yarn from that which is already in the aspirator **6,** and yarn can now begin to wind onto the chuck **C1.** By this time the predetermined delay period is completed and shot pin **20** is retracted from position I, allowing the aspirator **6** to continue moving in clockwise direction. As this takes place, cam switch **285***b* is lifted to prevent the shot pin **20** from entering into the hole at position II so that the aspirator **6** and the plate **18** will continue to rotate until the shot pin reaches and enters into the hole at position number III, but it is the rest position. During this time, cam switch **282***b* drops and chuck C2 which previously may have been in engagement with the drive roll **1,** moves out of engagement therewith.

In the second operating cycle, the second or rear yarn RY is now strung up on the machine. This is passed through the pigtail guide of the bottom guide BG and the free end of the yarn is then run into the aspirator **6.** The machine is started up again via the switches of control cabinet **14,** with the result that the shot pin **20** pulls out of the hole at position III and the aspirator begins to rotate. Cam switch **282***b* is lifted and causes chuck C2 to move back into engagement with the drive roll **1.** As the aspirator **6** continues to move in clockwise direction towards the transfer position IV, cam switch **284***b* is lifted and causes yarn pusher YPB to be extended, followed after a pneumatic delay by movement of swing arm **9** to the full-line position of FIG. **3.** The yarn RY is now engaged and severed by the cutter **17** on chuck **C2,** so that winding commences onto this chuck. With both yarns now strung up, operation is automatic from here on. The machine is now ready for transfer of yarn FY from chuck C1 to chuck C3 during the third operating cycle.

Subsequently shot pin **20** enters the hole at transfer position IV and at the same time cam switch **285***a* drops, activating the present delay. As the swing arm **9** reaches its full-line position in FIG. **3,** cutter **16** operates but since this is still a string-up operation no yarn will be present and none can be cut. At the end of the predetermined delay the shot pin **20** pulls out of the hole at transfer position IV and the aspirator **6** continues to rotate in clockwise direction. As it does so, cam switch **285***b* is lifted and, in conjunction with the already activated cam switch **284***a*, the yarn pusher YPA is now caused to extend (towards the left in FIG. **1**). The yarn guide provided on the yarn pusher YPA then pushes out the front yarn FY towards the left (in FIGS. **1** and **10**), causing it to be disengaged by the traverse guide **4.** After the earlier-mentioned time delay, the swing arm **9** moves forwardly to the full line position FIG. **3,** picking up the front yarn FY with its guide plate **13.** Meanwhile, the aspirator **6** has continued to rotate in clockwise direction and the shot pin **20** now enters into the hole at transfer position IV, and at the same time cam switch **285***a* drops to start the pre-programmed delay period. As the swing arm **9** reaches the end of its forward travel, that is moves finally into the position shown in full lines in FIG. **3,** its cutter **16** operates; and cuts the yarn which is engaged by the guide plate **13.** Sine the yarn is located directly adjacent and in front of the open end of the aspirator **6** at this time, the yarn is sucked into; the aspirator **6** and passes through the axis **1***a* to be accommodated in a waste bin or the like located at the rear of the winder. Subsequent to the cutting of the arm and its engagement by the aspirator **6,** the pre-programmed delay is completed, the shot pin **20** pulls out of the hole at position IV and the aspirator **6** begins its clockwise travel again. Because at this time the cam switch **285***b* is activated, the shot pin **20** does not enter into the holes at positions I and II, but will enter only into the hole at position III at which time the free end of the aspirator with the front yarn FY which is continuously running into the latter, will be located opposite chuck **C3.** During the travel of the aspirator **6** to this position, cam switch **281***b* drops and causes chuck C1 to move away from the drive roll **1,** that is towards the right in FIG. **10.** At the same time as the shot pin **20** enters into the hole at position III, the cam switch **284***b* is released and causes the cylinder of yarn pusher YPA to retract the same, followed after the programmed delay by movement of the swing arm **9** back to its broken-line position of FIG. **3.** This movement allows the yarn FY to recede enough from the plane of the drawing in FIG. **10** so that it can come in contact with a pickup and cutter device **17** on chuck C3 which device entrains the yarn, forming a transfer tail, and cuts it off the portion already in the aspirator **6.** Since the chuck C3 of course rotates at this time due to its engagement with the drive roll **1,** winding of a yarn package on chuck C3 now begins.

At this time the operator (or even an automatic doffing mechanism) removes the yarn package from chuck C1, and also during this time the winder now forms yarn packages on chucks C2 and C3.

When the yarn package on chuck C2 is completed the fourth cycle commences. The shot pin 20 is withdrawn from the hole at position III, permitting the aspirator to begin its clockwise movement. Cam switch 281*b* lifts, causing chuck C1 (on which a new bobbin tube has been installed) to move into engagement with the drive roll 1. This is the position shown in FIG. 11. Yarn guide TG now moves rearwardly and guide BG moves forwardly, each with its associated yarn. Cam switch 283*b* also lifts, immediately followed by cam switch 284*b*, so that the yarn pusher YPA is extended to the left and pushes the yarn RY to the same direction and out of engagement with the traverse guide 4. After the programmed delay the swing arm 9 moves forwardly to the full line position of FIG. 3 and its guide plate 13 engages the yarn RY and pushes it forwardly for engagement by the aspirator 6 whose free end will become positioned adjacent the rear yarn RY when the shot pin 20 enters into the hole at transfer position IV, at which time the aspirator 6 is temporarily arrested as the cam switch 285*a* drops to initiate the programmed delay. The positioning of the aspirator 6 by entry of the shot pin into the hole at transfer position IV takes place just as the swing arm 9 reaches the full-line position and its cutter 16 cuts the yarn, so as to sever it from the package which has been formed on chuck C2 and to permit the cut end (the free end of the incoming running yarn) to be drawn into the aspirator 6.

After the pre-programmed delay in the movement of the aspirator 6 has ended, which delay is of course so selected as to be just long enough to permit the proper positioning of the yarn and its engagement by the aspirator, shot pin 20 is pulled out of the hole at position IV and the aspirator 6 moves in clockwise direction until the shot pin 20 reaches the hole at position I into which it engages, thus arresting the free end of the aspirator adjacent the free end of the chuck C1. Cam switch 285*a* now drops, initiating a further delay and at the same time cam switch 284*b* drops, causing pusher YPA to retract and swing arm 9 to move back to its broken-line position. This latter movement permits the rear yarn RY which is engaged by the aspirator (see FIG. 11) to come into range of the pickup and cutter device 17 on the free end of chuck C1, which device engages the yarn and cuts it, whereupon winding of a package on chuck C1 begins. When the programmed delay has ended, shot pin 20 is retracted from the hole at position I and aspirator 6 continues to move in clockwise direction. Cam switch 285*b* is lifted and prevents shot pin 20 from entering into the hole at position II, so that the aspirator continues to move in clockwise direction until the shot pin enters into the hole at position III and the aspirator has reached its rest position again. During the movement of the aspirator to this rest position, cam switch 282*b* drops, causing chuck C2 to move towards the left in FIG. 11 out of engagement with the drive roll 1, so that the package on chuck C2 can be removed. Also, cam switch 284*a* drops and cam switch 281*a* lifts, in preparation for movement of the appropriate yarn pushers during the next operating cycle.

This fifth operating cycle begins when the yarn package on chuck C3 has reached its desired size and the shot pin 20 is retracted from the hole at position III, permitting the aspirator 6 to move in clockwise direction. At the same time, cam switch 282*b* lifts, permitting chuck C2 to move back into engagement with the drive roll 1, and cam switch 284*b* is operated. This causes the yarn pusher YPB to extend and push the front yarn FY, which has been running onto chuck C3, to the left and out of engagement with the traverse guide 4. After the previously mentioned delay, the swing arm 9 moves forwardly, engaging the front yarn FY with its guide plate 13 and pushing the front yarn FY to the left, that is to the position shown in FIG. 3. The shot pin 20 now enters into the hole at transfer position IV as a result of continued movement of the aspirator 6, and at the same time cam switch 285*a* drops and initiates the programmed delay. When the swing arm 9 reaches its full line position in FIG. 3, the front yarn FY is cut by its cutter 16 and the free end of the running front yarn FY is engaged and drawn into the aspirator 6 which is in position to do so at this time. Upon completion of the delay period the shot pin 20 is withdrawn from the hole at position IV and aspirator 6 again moves in clockwise direction. Cam switch 285*b* is lifted so that shot pin 20 by-passes the hole at position I, and subsequently switch 285*b* drops so that the shot pin will then enter into the hole at position II so that the free end of the aspirator 6 is located opposite the free end of chuck C2. Cam switch 285*a* now drops, initiating a further delay and at the same time cam switch 284*b* also drops, causing pusher YPB to retract and subsequently the swing arm 9 to move back to its broken line position. This allows the yarn FY to be engaged and entrained by the pickup and cutter device 17 on chuck C2 (see FIG. 12) and to be cut so that it can then be wound onto the chuck C2. At the end of the delay period the shot pin 20 is withdrawn from the hole at position II and the aspirator continues to move until its shot pin enters into the hole at rest position III. During movement to this rest position the cam switch 281*a* drops and the switch 284*a* is lifted, preparing the yarn pushers for the next operating cycle. During this time, also, the cam switch 283 drops and causes chuck C3 to move towards the left, away from the drive roll 1 so that the yarn package on this chuck can be doffed.

The sixth cycle begins as the yarn package on chuck C1 has reached full size and the yarn running onto chuck C1, namely the yarn RY, is to be transferred to chuck C3. To initiate this cycle the shot pin 20 is withdrawn from the hole at position III and the aspirator begins to move in clockwise direction. Cam switch 283*a* lifts and causes chuck C3, from which the package has been removed and on which a new empty bobbin tube has been installed to move towards the right into contact with the drive roll 1. Cam switch 284*b* lifts, causing the yarn pusher YPA to extend towards the left and pick up the rear yarn RY which is running onto chuck C1. Swing arm 9 moves forward to its extended position, picking up the yarns RY with its plate 13 and holding it ready for engagement by the aspirator 6. When the aspirator 6 has reached the transfer position IV the shot pin 20 enters into the hole at that position and at the same time cam switch 285*a* drops, initiating the programmed delay. As the swing arm 9 reaches its full line position the cutter 16 cuts the rear yarn RY running onto the chuck C1, so that the loose end of the running yarn can be aspirated into the aspirator 6. At the end of the delay the shot pin 20 is withdrawn from the hole at position IV so that aspirator 6 can continue

to rotate in clockwise direction. Meanwhile, cam switch **285***b* has been raised so that the shot pin bypasses the holes at position I and II and enters only into the hole at position III after cam switch **285***b* has dropped again. At the same time, cam switch **285***a* drops and initiates a further delay, and also cam switch **284***b* drops and causes the yarn pusher YPA to retract. Subsequently, swing arm **9** returns to its retracted position (the broken-line position in FIG. **3**), permitting the rear yarn RY which is engaged by the guide plate **13** to move into contact with the pickup and cutter device **17** on the free end of chuck **C3**, which device entrains the yarn RY and cuts it off the portion in the aspirator, so that the yarn can now wind onto chuck **C3**. Cam switch **281***b* drops and causes chuck C1 to move out of engagement with the drive roll **1** for removal of the finished yarn package.

The six operating cycles constitute a complete operating sequence of the winder and are constantly repeated in this sequence. However, because the first cycle described herein was actually a string-up cycle and did not take place as part of the automatic operation of the winder, it is necessary to examine one more cycle which is the first cycle of the operating sequence when the winder operates fully automatically. This is necessary because one of the operations which took place in the first cycle previously described produced no direct result, namely the operation relating to the movement of the yarn pusher YPC. A comparison of the cycle description which follows with the description of the first cycle that was given earlier will show the difference. When yarn is to be transferred from chuck C2 to chuck C1 upon completion of the package on the former, the shot pin **20** is withdrawn from the hole at position III and the aspirator begins to move in clockwise direction. Yarn guide TG now moves forward and guide BG moves rearward, each with its associated yarn. Cam switch **281***b* lifts, causing chuck C1 to move into engagement with the drive roll **1**, and cam switch **283***b* drops. Approximately at the same time cam switch **285***c* lifts, preparing pusher YPC for movement. This takes place as cam switch **284***b* lifts, causing the yarn pusher YPA and YPC to move out towards the left, resulting in pushing-out of both of the yarns FY and RY out of engagement with the traverse guide **4**. Subsequently, the swing arm **9** moves to its forward full-line position in FIG. **3**, picking up both of the yarns FY and RY with its guide plate **13** which for this purpose is provided with two separate pick-up notches as shown in FIG. **1**. The yarn which has been moved out by pusher YPA and which is at this time running onto chuck **C2**, is engaged by the cutter **16** on the swing arm, whereas the yarn pushed forward by the pusher YPC is merely picked up by one of the notches on the plate **13**.

Now the shot pin **20** enters into the hole at transfer position IV and at the same time cam switch **285***a* drops, initiating the programmed delay. When the swing arm **9** reaches its forward position, that is the full-line position, the yarn running onto the chuck C2 and engaged by the cutter **16** is cut by the latter, and its free end is picked up by the aspirator **6** into which it is drawn. At this time the pusher YPC is retracted, for instance by operating a valve which switches off the supply of air to its cylinder in response to operation of the cutter **16**, and the yarn engaged by the pusher YPC can thus move back into engagement with the traverse guide **4**. At the end of the delay the shot pin **20** is withdrawn from the hole at position IV and the aspirator **6** continues to move in clockwise direction until the shot pin **20** enters into the hole at position I and cam switch **285***a* drops, initiating a further delay. Also at the same time cam switch **284***b* drops to permit pusher YPA to retract and swing arm **9** to move back to its broken line position, thus allowing the yarn engaged by the swing arm to become engaged and entrained by the pickup and cutter device **17** on chuck **C1**, whereupon it will be cut and begin to wind onto the chuck **C1**, At the end of the delay the hot pin **20** is withdrawn from the hole at position I an the cam switch **285***b* is lifted, so that as the aspirator **6** continues to move in clockwise direction it will bypass the hole at position II and its shot pin will enter into the hole at position III. During this movement the cam switch **282***b* drops, causing chuck **C2** to move out of engagement with the drive roll **1** so that the yarn package can be removed from this chuck. Also, cam switch **285***c* drops and switches **284***a* and **281***a* respectively drop and rise in order to prepare pushers YPA and YPB for the next operating cycle.

The periods at which transfer of yarn from one chuck to another is initiated will depend upon the size of yarn packages to be formed on the respective chuck; a timer can be provided which can be set as desired in accordance with the time period required for a yarn package of desired size to be formed on a respective chuck. The respective yarn will of course always be in contact with the circumferential surface of the drive roll as it runs onto one of the chucks or is transferred from one to another chuck.

It is clear that with this construction two yarn packages are being wound simultaneously and that the yarn (whether there be one or more) will always run continuously without ever having to stop due to the fact that during the transfer of yarn from one chuck to another the running yarn passes through the aspirator and out the open end of the axis **1a** at the rear side of the apparatus. Also, the provision of the yarn pushers YPA and YPB, and their guides TG and BG, assures that the problem of crossed and entangled yarns is avoided, because the yarn to be transferred from one chuck to another can be made to pass behind the running yarn (which is being wound onto a package that is not yet completed), whereby crossing and entangling of the yarns is avoided.

At such times as the problem of crossed and tangled yarns could occur (in the absence of the provisions made herein) the yarn pushers and guides are appropriately operated. If it is assumed that the second yarn closest to the plane of FIG. **2** (and left-most in FIG. **3**) is the running yarn which is provided in guide BG and being wound onto a package, and the first yarn behind it is provided in TG and has completed the formation of a package and is to be transferred to a waiting reserve chuck, then transferring the first yarn would obviously cause it to tangle with the second yarn. This is avoided by operating guide BG which shifts the second yarn rearwardly with reference to the plane of FIG. **2**, and operating guide TG which shifts the first yarn forwardly with reference to the same plane. Now, pusher YPA io operated to shift the first yarn to the left in FIG. **2**, and pusher YPC is operated to shift the second yarn in the same direction but not quite as far as the pusher YPA shifts its first yarn to the left. Both yarns now continue to run in parallel and are engaged by the guide

plate 13 of the swing arm 9 into the two notches of which they respectively enter. This effectively avoids any tangling or crossing of the yarns, as well as rubbing of the same against each other, which could lead to yarn damage

The first yarn can now be engaged by the aspirator as previously described, and cut off for the package onto which it has been winding, by the swing arm cutter 16. At this time, the second yarn is allowed to return into engagement with the guide element of the traverse guide 4, by retracting yarn pusher YPC (to the right in FIG. 2), which yarn pusher is operated in response to operation of the swing arm cutter 16.

It is also possible to make the speed at which the swing arm 9 is retracted from its full-line position to its broken line position in FIG. 3, variable so that a variation in the length of the transfer tail being formed on the respective package can be obtained. This will be described in more detail later with respect to FIGS. 20–27.

THE YARN ASPIRATOR

Details of the aspirator 6 are illustrated in FIGS. 15 and 16. The aspirator has certain features which are most important in conjunction with the overall operation of the novel winder. On the one hand, the construction of the aspirator, details of which will be discussed presently, assures that the yarn can easily and with strong suction be drawn through a 180° bend which is required in order to permit the yarn to be passed through the axis 1a of the drive roll to the rear side of the wnder, contrary to conventional practice where the yarn is discharged at the front of the winder. Furthermore, the discharge of the waste yarn in this manner, namely to the rear of the winder, is possible at all only by having the aspirator 6 mounted on the hollow axis 1*a* of the drive roll, thereby greatly simplifying the disposal of water yarn as outlined earlier.

In addition the particular mounting of the aspirator, which has been chosen in accordance with the present invention, provides the aspirator at a location which is ideal for wrapping the yarn engaged by the aspirator around the drive roll, and in particular wrapping it around the drive roll in the direction of the running yarn being wound. The aspirator can thus reach all of the chucks equally well and uniformly, and simplicity of yarn transfer is thus achieved with a minimum of complicated construction.

With this in mind it will be seen that FIGS. 15 and 16 show details of the aspirator 6. Reference numeral 160 identifies an outer tube into which air is blown in the direction of the arrows in FIG. 16, and reference numeral 161 identifies an inner tube which is curved in substantial U-shape and through which air is drawn, also in direction of the arrows shown in FIG. 16. The interior passage of the tube 161 is identified with reference numeral 166. The end portion of the tube 161 is identified with reference numeral 162 and a cross tube extending from the tube 160 with which it communicates, to the end portion 162, is identified with reference numeral 163. Reference numeral 164 designates an annular passage formed in the end portion 162, and reference numeral 165 designates screw threads formed in the free end of the end portion 162. The inlet end of the passage 166 is designated with reference numeral 166*a*.

A cap 167 (omitted in FIG. 15) is provided which can be threaded onto the screw threads 165 of the end portion 162. It has a transverse end wall 167*a* which is formed with an inlet opening 168 into which yarn Y is to be aspirated. A cylindrical member 169 is located within the confines of the cap 167 and provided with a center passage 170 and with a plurality of axially extending grooves 171 in its outer circumferential surface. An O-ring 172 is compressed between the member 169 and the free end of the end portion 162 so as to seal the passage 164 from the passage 166*a*. A cylindrical guide member 173 is located in the passage 170 of the member 169 and is itself provided with a center passage 175 which communicates with the opening 168 and with the inlet end 166a of the passage 166. The outer circumferential surface of the member 173 is formed with a plurality of helically twisted grooves 174 which also communicate with the inlet end 166*a* and, in addition, with a space 167*b* existing between a sealing member 176 and the member 169, so that the grooves 174 are in communication with the grooves 171 as shown in FIG. 16. It will be appreciated that as air under pressure is blown through the outer tube 160 it will pass via the tube 163 into the grooves 169, from there into the space 167*b* and then into the grooves 174 to issue into the inlet end 166*a* of the tube 161. This creates suction in the tube 161, drawing the yarn Y into the inlet end 168. Due to the fact that the air is caused to swirl on entry into the inlet end 166a, as a result of its passage through the helical grooves 174, a particularly good aspirating effect is obtained which reliably assures the passage of the yarn Y through the bend in the tube 161 and into the axis 1*a*.

THE SWING ARM YARN CUTTER

Another important feature according to the present invention is the yarn cutter 16 provided in the swing arm 9. This cutter is of the anvil type and is necessary to sever the running yarn from the yarn package that has already been formed on one of the chucks. The cutter must be highly reliable and rapid in its operation, and must be operable at a required moment in time.

Such a construction is obtained with the cutter 16 which is illustrated in more detail in FIGS. 17, 18 and 19. As shown there, reference numeral 190 designates a housing that is mounted, as diagrammatically illustrated in FIG. 19, on the swing arm 9. The housing 190 is formed with an interior chamber 191 which has an open side. Furthermore, the housing 190 is also provided with a bore 192 which communicates with the chamber 101 in the region of the closed side (the rear wall) of the chamber 191. This bore can be connected with a pneumatic conduit 193 which has been diagrammatically illustrated in FIG. 19. A cover plate or anvil member 194 is provided which can be secured to the housing 190 in suitable manner, for instance by means of screws through the illustrated holes, so as to overly the open side of the chamber 191. FIG. 19 shows particularly clearly that the member 194 is provided with suitable apertures, such as the holes 196 (compare also FIG. 17) which extend from its side facing towards to its side facing outwardly away from the open side of the chamber 191. The side facing outwardly away from the chamber 191 is provided with a lead-spring 195 which is secured to the member 194 in appropriate manner, for instance by rivetting, by means of a screw or the like and a portion of which overlies the holes 196 as shown

in FIG. 17. The side of the member 194 which faces the chamber 191 is recessed as best shown in FIGS. 17 and 19. The rear wall of the chamber 191 is provided with a projecting stud 197 (see FIG. 19) and forwardly of the same there is lodged in the chamber 191 a diaphragm 198 which may also be provided with a projection 199 which engages the stud 197. The diaphragm 198 is so located that the bore 192 communicates with the chamber 191 rearwardly of the diaphragm 198. Forwardly if the diaphragm 198 there is accommodated in the chamber 19 a punch member 200 carrying at its side facing the anvil member 194 a projecting cutting edge 202. At opposite lateral sides of the cutting edge 202 there are provided two projections or pins 201 which extend into the holes 196 of the member 194. These are locating pins located on a common line transversely of the elongation of the cutting edge 202.

In operation of the cutter 16, yarn engaged by the plate 13 of arm 9 will be drawn into the space between the open side of the chamber 191 and the facing surface of the anvil member 194. It will thus extend across the cutting edge 202, being located in this position as it enters the space by the locating pins 201. This is shown most clearly in broken lines in FIG. 18.

When compressed air is admitted via the bore 192 into the chamber 199 behind the diaphragm 198, the spacing of which latter from the rear wall of the chamber is assured by cooperation of the portions 197 and 199, the diaphragm will be rapidly flexed outwardly (towards the right in FIG. 19), pushing the punch member 200 in the same direction. This causes the cutting edge 202 to cooperate with the anvil member 194, cutting the yarn Y located between the cutting edge and the anvil member 194 in a rapid and clean operation. The movement of the member 200 towards the right causes the locating pins 201 which are carried on the member 200 to deflect the spring 195 outwardly (towards the right in FIG. 19). Upon termination of the momentary admission of compressed air via the bore 192, the spring 195 thus returns the member 200 to its position inwardly of the open side of the chamber 191, by pushing against the locating pins 201.

The cutter will thus be seen to be highly reliable in its operation, because the yarn Y will always be located in proper position relative to the cutting edge 202, extending across the same and being maintained in this position by the locating pins 201. Furthermore, due to the fact that the member 200 is always returned within the chamber 191 immediately upon termination of the admission of compressed air, the space for admission of the yarn Y to be cut, is always unobstructed.

THE YARN PICK-UP AND CUTTER DEVICE ON THE CHUCKS

Another very important component of the apparatus according to the present invention is the yarn pick-up and cutter device 17, of which one is provided on the free end of each of the chucks C1, C2 and C3. The construction of the device 17 is shown in detail in FIGS. 20 and 21, and its operation is shown sequentially in FIGS. 22–27.

Discussing firstly FIGS. 20 and 21 it will be seen that each device 17 comprises a mounting member 210 which may be of substantially cylindrical configuration, as shown. This mounting member is secured in appropriate manner forming no part of the present invention, on the free end of the respective chuck. An exposed end face 210*a* of the mounting member 210, which end face faces axially away from the chuck on which the member is mounted, has secured to it in overlying relationship but with some spacing from the surface 210*a*, a yarn engaging member 211 of the particular configuration which is shown most clearly in FIG. 20. The member 211 has in its arcuately recessed side two depressions, namely a smaller depression or recess 219 and a larger depression or recess 220. It is further provided with two rounded lobes 217 and 218 of which the latter separates the recesses 219 and 220 as shown. A cutter blade 212 is releasably mounted on the side of the member 211 which faces away from the surface 210*a*, bridging the recess 220 somewhat inwardly of the open side thereof. It should be noted that the thickness of the member 211, that is its dimension measured between its two opposite major surfaces, increases from the end which is the right-hand end in FIG. 20 towards the left-hand end. Thus, when the member 211 is mounted on the surface 210*a*, it can be in direct engagement with this surface at its left-hand end and will yet be spaced from the surface 210*a* in the region of the recesses 219 and 220 and the lobes 217 and 218.

A pair of holes 216 are provided in the surface 210*a* from which they extend inwardly, and a wire bracket 213 of substantially U-shaped outlines has its two legs received in these holes 216, respectively. A pusher pin 214 is provided having a portion of reduced cross section which is received in and serves as a guide for a helical expansion spring 215, the latter bearing upon the surface 210*a* or, preferably, being in part received in an additional hole formed therein. Thus, the spring 215 urges the bracket 213 outwardly away from the surface 210*a* and into biased engagement with that side of the member 211 which faces the surface 210*a*. The location of the bracket 213 and of the pusher pin 214 are shown in broken lines in FIG. 21 with reference to the member 211. Located at opposite sides of the bight portion of the bracket 213 are two locating pins 210b which project into engagement with the member 211 and serve, as will be discussed presently, the same purpose as the locating pins 201 in FIG. 17.

The device 17 serves to pick up the running yarn which passes through the aspirator 6, when the inlet opening of the aspirator 6 is located adjacent the free end of the respective chuck, and thus adjacent the devices 17 thereon. The yarn which is so held and passes through the aspirator, will be located forwardly of the device 17 due to the fact that it is pushed in such a position by the swing arm 9 which at the time the aspirator 6 stops adjacent the respective chuck is in its full-line position shown in FIG. 3. When the swing arm 9 then moves back to its broken line position shown in FIG. 3, the inclination of the running yarn coming from above and entering into the aspirator 6 will change, that is the yarn will move into contact with the member 210 so that it can be engaged by the device 17.

A sequence of operation of the device 17 is illustrated in FIGS. 22–27. FIG. 22 shows, by way of example, that the aspirator 6 is in such a position as to have its open inlet end adjacent the chuck C1 which is in engagement with the drive roll 1 and is being rotated by the same. The yarn Y passes through the diagrammatically illustrated traverse guide 4 and around the drive roll 1 and enters the inlet of the aspirator 6 at a point

designated with reference numeral 221. In FIGS. 23–27 the showing of the drive roll and aspirator has been omitted for clarity and only the reference point 221 is illustrated. In other words, as far as the pick up device 17 is concerned, the point 221 to which the yarn extends from above (after in this instance first passing around the drive roll 1) is stationary in space because the aspirator 6 does not of course rotate during the pickup.

When the non-illustrated swing arm 9 moves back to its broken line position in FIG. 3, this changes the angle at which the yarn Y moves onto the drive roll 1, so that the yarn shifts on the drive roll 1 axially towards the device 17 on the chuck C1, that is in the direction away from the viewer of FIG. 22. That portion of the yarn which extends from its point of last contact with the drive roll surface to the point 221 at which it enters into the aspirator 6, will now move into the pickup range of the device 17. In so doing it will be engaged during rotation of the chuck C1 by the lobe 217 as shown in FIG. 23. Since the chuck continues to rotate in counterclockwise direction (see FIG. 22) the engaged part of the yarn Y (which is held at point 221) will slip over the rounded lobe 217 and enter the recess 219. This is shown in FIG. 24. During continuous rotation of the chuck C1 the yarn will now slip between the spring-biassed bracket 213 and the member 211, to thus be clamped. It cannot slip out from under the bracket 213 again, because it moves into contact with the locating pins 214 which prevent such a possibility. Since the yarn continues to be held at point 221, and since the chuck continues to rotate, the clamped yarn (the clamping position is shown in FIG. 25) now takes a turn which places it across the cutting edge of the blade 212, as shown in FIG. 26. As a result of this, the yarn Y is severed from that yarn portion which extends into the aspirator and this latter yarn portion, now being free, is sucked away by the aspirator and ejected through the axis 1*a*. Now, the running yarn coming from the traverse guide 4 is being wound onto the chuck C1. That portion of yarn Y which is clamped between the member 211 and the bracket 213, and which has been convoluted once or twice about the member 211 during the pick-up sequence just described, is a so-called transfer tail, that is it will hang free out of the yarn package finally formed. This is highly desirable because when such a package is later on placed onto a yarn processing machine, the transfer tail of the working package (the package from which yarn is being withdrawn) is tied by the operator to a similar transfer tail of a reserve package so that, when the first package runs out, yarn will be immediately and automatically withdrawn from the reserve package, eliminating the necessity for stopping the machine to thread up the next package.

THE PNEUMATIC SYSTEM

Coming, finally, to FIG. 28 it will be seen that in this Figure there is illustrated a pneumatic control system for controlling the operations which have been described heretofore. FIG. 28 is a pneumatic schematic and will be largely self-explanatory. Various components being controlled have been illustrated diagrammatically, and in particular there are shown the top guide TG, the bottom guide BG, the yarn pushers YPA, YPB and YPC. Also illustrated is the swing arm 9, the drive roll 1 with the aspirator 6, and the chucks C1, C2 and C3.

The sequencing of the various operations is effected by means of a plurality of cams 281, 282, 283, 284 and 285 (see also FIG. 3) located advantageously at the rear of the machine. For purposes of the diagrammatic illustration in FIG. 28, it is shown that each of the cams 281–284 has two cam portions which are diagrammatically shown in FIG. 28 asthe cam portions 281*a*, 281*b*, 282*a*, 282*b*, 283*a*, 283*b*, 284*a* and 284*b*. The cam 285 has three cam portions 285*a*, 285*b* and 285*c* (see also FIG. 3). Each of these cam portions cooperates with a pneumatic switch which are diagrammatically shown in FIG. 28 and are labelled. The connections between these switches and the various components being controlled by them are shown in FIG. 28. The switch controlled by cam portions 281*a* controls the operation of yarn pusher YPB, the switch controlled by cam portion 281*b* controls the movement of chuck C1 into and out of engagement with the drive roll. The switch controlled by cam portion 282*a* controls the program which effect return of the entire machine to string-up position, the switch associated with cam portion 282*b* controls the movement of chuck C2 and that associated with cam portion 283*a* controls the movement of chuck C3. The movements of top and bottom guides TG and BG are controlled by the switch associated with the cam portions 283*b*, and the switch associated with cam portions 284*a* controls movement of the yarn pusher YPA. The swing arm 9 is controlled by the switch associated with cam portions 284*b* are the previously mentioned delays in the retraction of the shot pin 20 from the holes at the respective locations I–IV (which delay of course imposes the corresponding delay in clockwise movement of the aspirator 6) are controlled by the switch associated with cam portion 285*a*. The actual movement of the shot pin 20, or rather the cylinder 21 associated therewith, is controlled by the switch associated with cam portion 285*b*, and the movement of the yarn pusher YPC is controlled by the switch associated with cam portion 285*c*. Thus, the operation of the machine can be controlled by the air logic system shown in FIG. 28. Of course, details of the various air switches and their interconnection have been omitted, because in themselves these features are not novel. It should also be understood that the operation of the machine could be controlled in other ways, for instance electrically.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of applications differing from the types described above.

While the invention has been illustrated and described as embodied in a yarn winder having an automatic yarn transfer system, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims.

1. An aspirator for yarn and the like, comprising

a substantially C-shaped tubular member having a center passage and two arm portions each provided with an open end of said passage, one of said open ends of one of said arm portions being adapted for connection with a source of suction;

wall means defining at the other of said open ends of the other of said arm portions an outer annular passage encircling said center passage and being open in the region of said other open end;

a cap mounted on said tubular member at said other end and having an interior open to both of said passages, and a transverse wall spaced from said passages and provided with an aspirating opening;

a first cylindrical member received in said interior defining a gap with said transverse wall and having a first axial bore communicating with said center passage and a plurality of axial grooves provided in a circumferential surface and each communicating with said annular passage;

a second cylindrical member received in said first axial bore and having a second axial bore coaxial and communicating with said other open end and said aspirating opening; and a plurality of axially extending helical grooves provided in a circumferential surface of said second cylindrical member; and

conduit means for connecting said annular passage with a source of gaseous fluid under pressure so that such fluid sequentially passes from said annular passage through said axial grooves, said gap and said helical grooves and into said other open end, receiving a helical motion during passage through said helical grooves.

2. An aspirator as defined in claim 1; and further comprising sealing means between said transverse wall and said second cylindrical member for preventing direct communication between said aspirating opening and said gap.

3. An aspirator as defined in claim 1; and further comprising cooperating engaging portions on said wall means and said cap for releasably connecting the latter with the former.

4. An aspirator as defined in claim 3, wherein said engaging portions are screwthreads provided on said wall means and said cap, respectively.

5. An aspirator as defined in claim 1; and further comprising a sealing ring between said first cylindrical member and said tubular member for preventing direct communication between said center passage and said axial grooves.

6. An aspirator as defined in claim 5, wherein said sealing ring is an O-ring.

7. An aspirator as defined in claim 1, wherein said conduit means comprises a first conduit portion extending from one to the other of said arm portions transversely thereof and communicating with said other open end, and a second conduit portion coaxially and with clearance surrounding said other arm portion and communicating with said first conduit portion.

8. An aspirator as defined in claim 1, wherein said aspirating opening is outwardly divergent for facilitating the entry of said yarn into said opening.

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