April 7, 1936. E. R. SWANSON 2,036,441

WINDING MACHINE

Filed Jan. 11, 1935 3 Sheets-Sheet 1

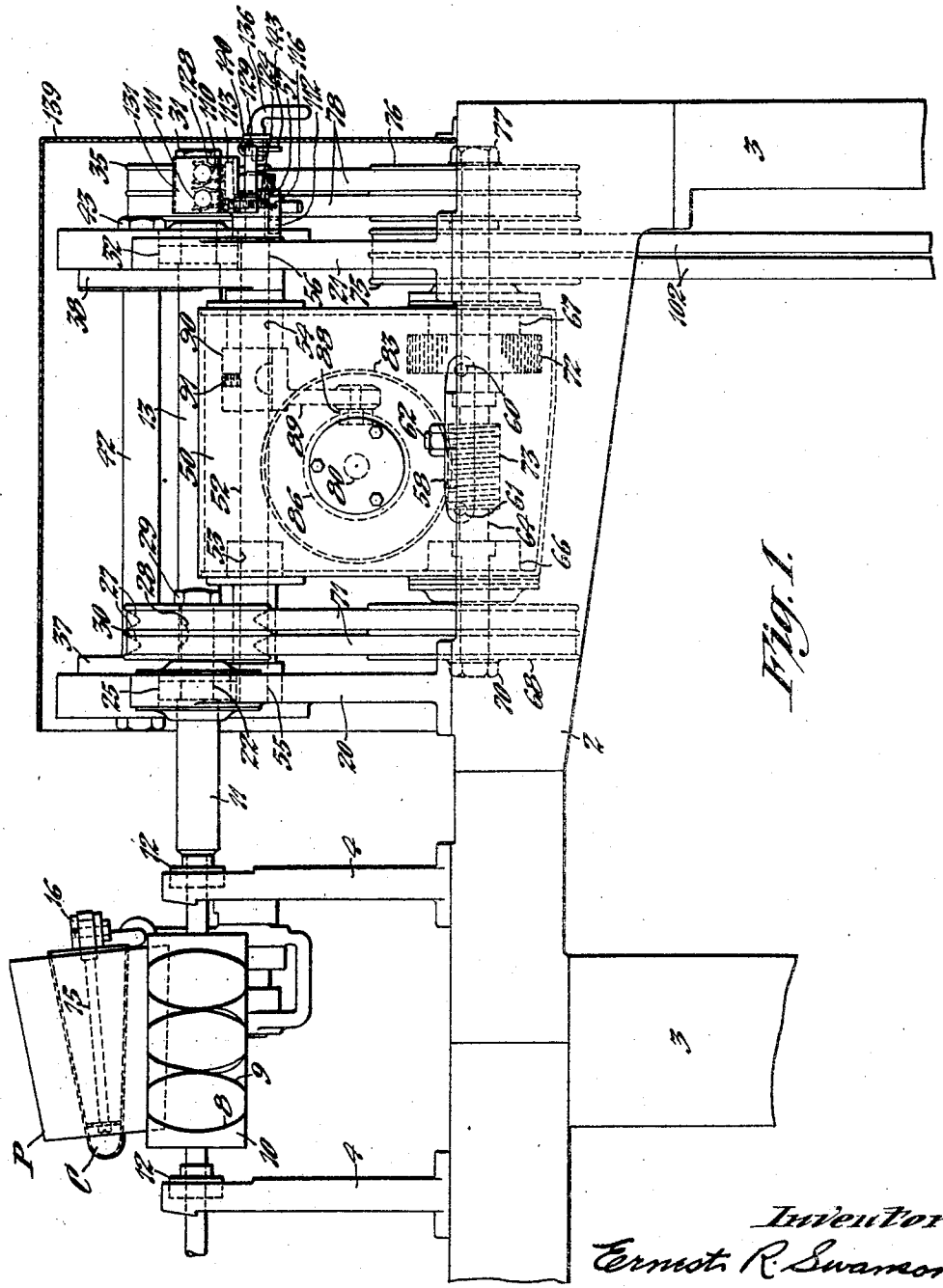


Fig. 1.

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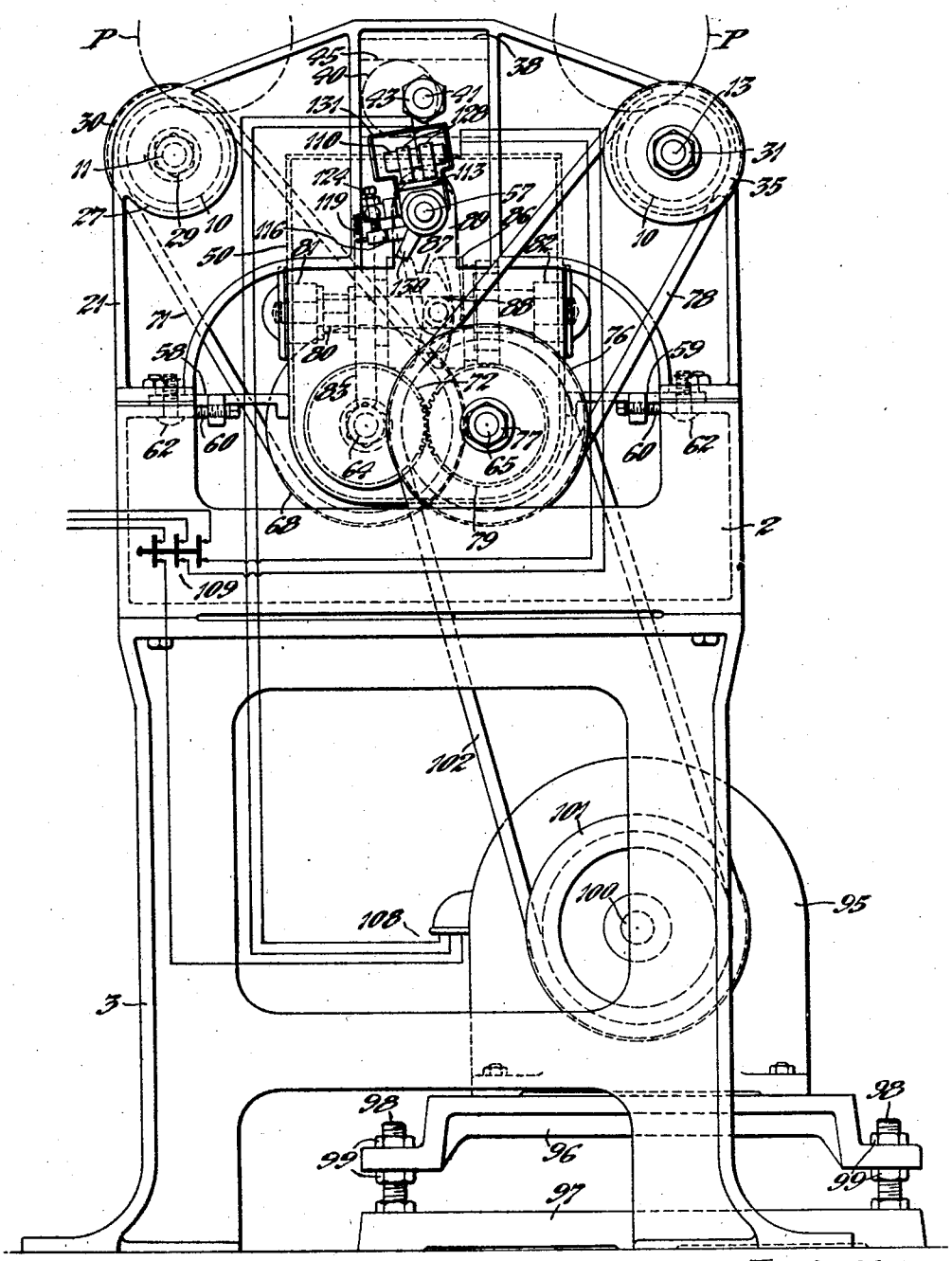


Fig. 2.

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April 7, 1936. E. R. SWANSON 2,036,441

WINDING MACHINE

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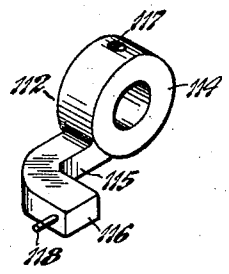


Fig. 7.

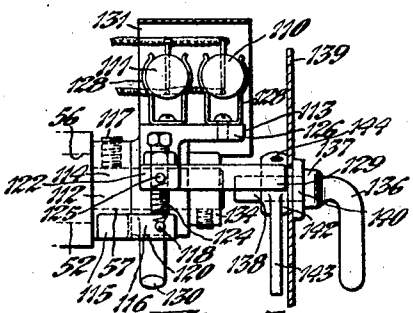


Fig. 3.

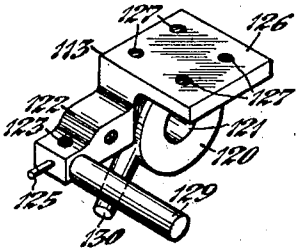


Fig. 8.

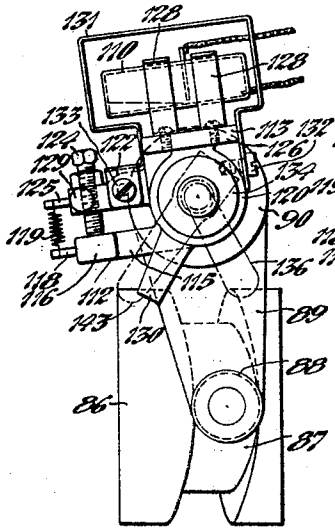


Fig. 4.

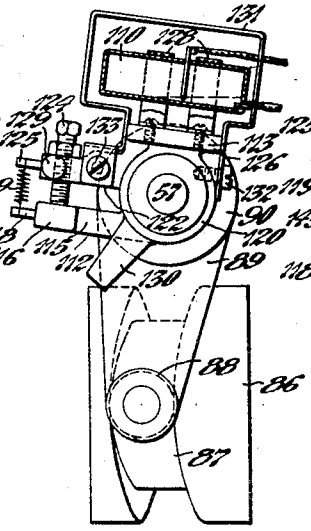


Fig. 5.

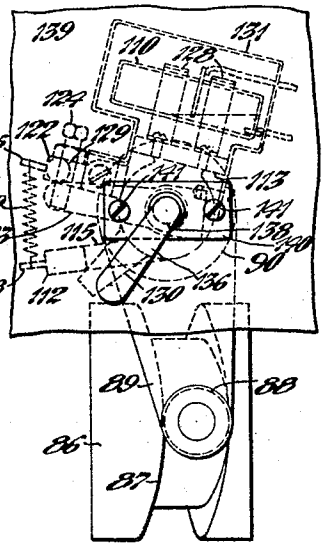


Fig. 6.

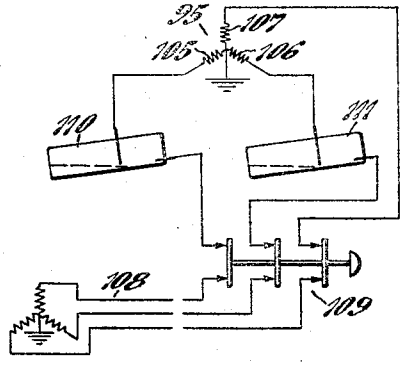


Fig. 9.

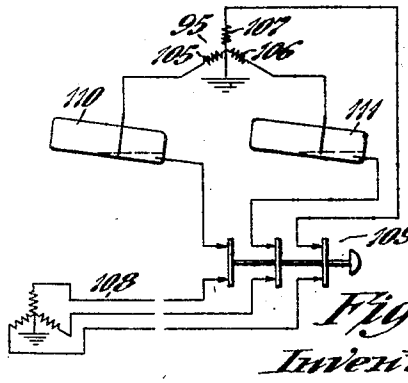


Fig. 10.

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Patented Apr. 7, 1936 2,036,441

UNITED STATES PATENT OFFICE

2,036,441

WINDING MACHINE

Ernest R. Swanson, Cranston, R. I., assignor to Universal Winding Company, Boston, Mass., a corporation of Massachusetts

Application January 11, 1935, Serial No. 1,427

21 Claims. (Cl. 242—18)

This invention relates to winding machines for winding cops, cones, cheeses and other forms of packages of thread, yarn, cord and similar strand material, hereinafter referred to generally by the term "yarn"; and particularly to winding machines wherein the package is rotated by contact with a drive-roll or drum. More specifically, the invention consists of a ribbon-breaker, so-called, which operates to control the disposition of the turns of winding on the surface of the package to prevent the formation of bands or "ribbons" in which the yarn coils are crowded together or "piled".

One object of the invention is to provide a simplified mechanism incorporated in the driving means of the winding machine and operating to disrupt the synchrony between the rotation of the package and the traverse of the yarn during the winding.

Another object of the invention is to provide a mechanism of the type indicated for periodically varying the speed ratio between the rotation of the package and the traverse of the yarn-guiding means at recurring cycles throughout the winding.

Another object of the invention is to provide a prime-mover for the driving means of the winding machine which operates to effect an acceleration and deceleration in the speed of one of the winding elements to cause slippage between the drive-roll and the package.

Still another object of the invention is to provide in a winding machine a mechanism for intermittently or continuously altering the electrical characteristics of a driving motor to cause the latter to operate at rapidly fluctuating rates of speed.

Another object of the invention is to provide a mechanism of the type indicated which is completely automatic in its operation and adjustable to meet all requirements.

Further objects of the invention are set forth in the following specification which describes a preferred form of construction of the device, by way of example, as illustrated by the accompanying drawings. In the drawings:

Fig. 1 is a front elevational view of one unit of a winding machine incorporating the novel features of the present invention and showing the control-mechanism for the variable speed prime-mover;

Fig. 2 is an end elevational view of the driving mechanism of the winding machine illustrated in Fig. 1 shown with the outer casing removed to disclose circuit-breaker control-mechanism;

Fig. 3 is a detailed view in side elevation of the circuit-breaker mounting;

Fig. 4 is an end elevational view of the circuit-breaker mounting and its operating mechanism showing the circuit-breaker open;

Fig. 5 is a view similar to Fig. 4 showing the circuit-breaker closed;

Fig. 6 is a view similar to Figs. 4 and 5 showing an auxiliary manually-operable means for the pair of circuit-breakers;

Fig. 7 is a detailed perspective view of a stop-rest for the circuit-breaker supporting frame;

Fig. 8 is a detailed perspective view of the supporting frame for the circuit-breakers;

Fig. 9 is a diagrammatic view of the electrical circuit showing the circuit-breakers in open position; and

Fig. 10 is a view similar to Fig. 9 showing the circuit-breakers in closed position.

The present invention relates generally to means for causing alternate acceleration and deceleration in the speed of one of the winding elements of the machine, for example, the drive-roll for rotating the package; or, in other instances, it may be applied to the drive for the yarn-traversing means when the latter is operated independently of the drive-roll. More specifically, the invention relates to an electric driving motor with automatically-operated mechanism for alternately opening and closing the circuit of one or more of its windings to decelerate and accelerate the speed of the motor.

Referring to the drawings, the winding machine herein illustrated, by way of example, is of the double gang type comprising a plurality of winding units arranged in series along the opposite sides of a horizontal frame or bed 2 which is supported at its ends by legs 3. Spaced along the top of the bed 2 are a series of brackets 4 which mount bearings for the driving shafts and other parts of the winding mechanism, two opposite units being located between each pair of brackets but only one unit being herein shown.

In the construction of the machine as shown in Fig. 1 the winding mechanism of each unit comprises only two principal elements, namely, the winding-mandrel or spindle 15 on which the yarn-receiver or cop-tube C is rotatably supported, and the drive-roll 10 for rotating the yarn-receiver and in which is embodied the means for traversing the yarn back and forth axially of the package being wound. In this form of construction the usual reciprocating thread-guide is dispensed with, the drive-roll

having its peripheral surface provided with a helical groove or grooves 8 and 9 extending in opposite directions and adapted to receive the strand of yarn to guide it back and forth between the ends of the package. This particular form of traversing means is shown and described in U. S. Letters Patent No. 1,749,355, dated March 4, 1930. It is to be understood, however, that the present ribbon-breaker or speed-changing device is adapted for use on winding machines of other types, for example, those wherein the package is driven by contact with a drive-roll and the yarn traversed by means of a reciprocating guide as illustrated and described in U. S. Letters Patent No. 1,656,088 issued January 10, 1928, or with any other arrangement of drum-driven winders.

In the form of construction shown in Fig. 1 the drive-rolls 10 are carried on and rotated by a horizontal shaft 11 journaled in ball bearings 12 on the bracket 4; the shaft 11 being extended throughout the whole length of the gang machine to carry the drive-rolls for any desired number of winding units. A second parallel shaft 13, also journaled in bearings on the bracket 4, carries the drive-rolls, not herein shown, for the other series of winding units arranged on the opposite side of the winding frame or at the right-hand side as viewed in Fig. 2.

The present machine is shown as adapted for winding packages of conical form with the yarn built up on a suitable axial core or receiver, a wooden or fiber conical cop-tube C being illustrated in Fig. 1 as mounted to rotate on the winding-spindle or mandrel 15. The winding-spindle 15 is swiveled to the forward end of a weighted arm 16 which is pivotally supported at its rearward end to adapt the surface of the yarn-receiver C, or of the package P, to be held in contact with the periphery of the drive-roll 10. As the yarn is built up on the cop-tube C it forces the latter upwardly with the arm 16 swinging on its pivot in the manner common to machines of the present type. Although not herein shown a suitable stopping mechanism is usually employed with each unit of the machine to automatically stop the winding operation by raising the package away from the drive-roll 10 in the manner illustrated and described in U. S. Letters Patent No. 1,895,741 issued January 31, 1933.

The driving transmission for the drive-roll shafts is similar to that shown and described in my copending application, Serial No. 741,012, filed August 22, 1934, and is therefore described but briefly herein. Bolted to the top of the bed 2 are a pair of spaced brackets or cross-frames 20 and 21 for supporting the ends of the drive-roll shafts 11 and 13 and the driving transmission therefor. The drive-roll shaft 11 projects beyond the bearing 12 in the bracket 4 with its reduced extremity 22 journaled in a ball bearing 25 on the cross-frame 20, as indicated generally in Fig. 1. A belt-pulley 30 is keyed at 28 to the reduced end 22 of the shaft 11 and held against axial movement by a nut 29. The periphery of the pulley 30 is provided with spaced V-shaped grooves 27 for receiving a pair of driving belts as later described.

The opposite drive-roll shaft 13 is somewhat longer than the shaft 11 with its reduced end projecting through a clearance opening in the frame member 20 and journaled in a ball bearing 32 in the frame member 21. Mounted fast on the reduced end of the shaft 13 is a pulley 35 of the same form and size as the pulley 30 previously described. The pulley 35 is suitably keyed to the shaft 13 and held against axial movement by a nut 31 as shown in Fig. 2.

Arranged for vertical adjustment on the facing sides of the frame members 20 and 21 are two complementary brackets 37 and 38 received in grooves or guideways on the frames and held in adjusted position by means of disks 40 eccentrically mounted on a stud-shaft 42, see Fig. 2. The ends 41 of the shaft 42 project through bearing apertures in the cross-frames 20 and 21 with nuts 43 screwed onto their threaded extremities and set up against the sides of the frames to hold the shaft from turning. The peripheries of the eccentric disks 40 engage the opposite sides of horizontal slots 45 formed in the brackets 37 and 38 as shown in Fig. 2.

An enclosing housing or cradle 50 mounted between the cross-frames 20 and 21 carries the driving transmission for the drive-shafts 11 and 13. The housing 50 is suspended between the brackets 37 and 38 on a rock-shaft 52 passing through bearing apertures 53 and 54 in the end walls of the housing and extending into bearing apertures 55 and 56 in the brackets. The rearward end of the rock-shaft 52 extends beyond the cross-frame 21 as shown in Fig. 1 for supporting the circuit-breaking mechanism to be later described.

The housing 50 is prevented from movement about the rock-shaft 52 by arms 58 and 59 engaging the sides of the housing. The arms 58 and 59 are slidably mounted on the machine bed 2 at opposite sides of the housing 50 and are moved into engagement with the walls of the housing by adjusting screws 60 and 61 carried in depending webs on the arms and engaging the sides of the bed. The arms 58 and 59 are held against the top of the bed 2 by bolts 62 passing through slots in their ends, see Fig. 1. The housing 50 may be vertically adjusted to any desired position with respect to the cross-frames 20 and 21 by rotation of the eccentric disks 40 on the stud-shaft 42.

A pair of driving shafts 64 and 65 are mounted in bearings in the housing 50 in spaced parallel relation below the rock-shaft 52. As shown in Fig. 1, the drive-shaft 64 is journaled in bearings 66 and 67 on the opopsite end walls of the housing with its forward end extending beyond the housing to receive a pulley 68 keyed thereto and held axially by a nut 70. The periphery of the pulley 68 is provided with spaced V-shaped grooves in alinement with grooves 27 on the pulley 30, previously mentioned, and the two pulleys are connected by a pair of endless belts 71 extending therebetween. The opposite end of the shaft 64 terminates in the bearing 67 in the end wall of the housing, and adjacent the bearing a spur-gear 72 is fixed on the shaft. The shaft 64 is also provided with a worm 73 intermediate its ends and within the housing 50 which may be formed integral with the shaft or constructed separate therefrom and secured fixedly thereon.

The shaft 65 is similarly mounted in suitable bearings in the end walls of the housing 50 with its rearward end extending outwardly from the housing to receive a pair of pulleys 75 and 76 keyed thereto and held axially thereon by a nut 77. The pulley 76 is alined with the pulley 35 on the shaft 13 and the two pulleys are connected by a pair of belts 78. Within the housing is a spur-gear 79 fixedly mounted on

the shaft 65 and intermeshing with the gear 72 on the shaft 64 to connect the two shafts to be driven together. A cam-shaft 80 is suitably journaled in bearings 81 and 82 in the side walls of the housing 50 and is provided with a suitable worm-wheel or gear 83 engaging the worm 73 on the driving shaft 64. A cam 86 fixed to the shaft 80 intermediate its ends has a helical groove 87 to receive the roller 88 of a follower arm 89 fixedly connected to the rock-shaft 52. As most clearly shown in Fig. 1, the follower arm 89 depends from a hub 90 keyed to the shaft 52 and held against axial movement by a set-screw 91. With the construction described the cam-shaft 80 is rotated at a reduced speed from the driving shaft 64 to cause the cam 86 to oscillate the rock-shaft 52 by the engagement of its groove 87 with the roll 88 on the follower arm 89 on the rock-shaft. The rock-shaft 52 may be continuously rocked to its extreme alternate positions or may be intermittently actuated in accordance with the contour of the cam-groove 87 which may be varied from the form shown in the drawings.

A prime-mover for driving the shaft 65 is provided in the form of an electric motor 95 which is mounted on a suitable pedestal 96 adjustably supported from a base 97 by means of studs 98 and adjusting nuts 99. The motor 95 is positioned below the bed 2 at the rearward end of the winding machine, as viewed in Fig. 2, and in driving relation to the shaft 65. Mounted on the armature shaft 100 of the motor 95 is a double-grooved driving pulley 101 disposed in alinement with the pulley 75, the two pulleys being connected by a pair of belts 102.

In accordance with the present invention means are provided for intermittently or continuously varying the speed of the prime-mover or motor to cause slippage between the surface of the package and the periphery of the drive-roll whereby to break the synchronism between the rotative speed of the package and the rate of traverse of the yarn. Broadly, the invention contemplates means for varying the electrical characteristics of the driving motor to cause alternate deceleration and acceleration in its speed which is transmitted to the drive-roll 10. In a preferred embodiment of the invention, as indicated diagrammatically in Figs. 9 and 10, the driving motor 95 is of the type having three phase-windings 105, 106 and 107 connected with a source 108 of a usual three phase power line through a circuit-breaker 109 for starting and stopping the motor. In circuit with two of the phase-windings 105 and 106 are automatically-operated circuit-breakers 110 and 111 for alternately opening and closing the motor winding circuits to cause a deceleration and acceleration in the speed of the motor.

The circuit-breakers are preferably of the tilting liquid-contact type employing mercury and commonly known as a "mercury switch"; it having been found that these switches operate satisfactorily over a long period of time and entirely eliminate any fire hazard because of their enclosed construction. The circuit-breakers are preferably operated directly by the driving mechanism of the machine. The invention, however, is not limited to the form of circuit-breakers shown nor to circuit-breakers operated directly by the winding machine as any other suitable form of current-interrupting means may be used, and their operation might be controlled by mechanism independent of the winding machine to perform the desired function.

In the present embodiment of the invention, as shown in Figs. 3 to 6, the circuit-breakers 110 and 111 are mounted on a supporting bracket 113 carried by the extended end 57 of the rock-shaft 52 with a stop-rest 112 for controlling their position. The stop-rest 112 and supporting bracket 113 are adapted for oscillatory movement with the rock-shaft 52 to tilt the circuit-breakers or switches 110 and 111 from an open position as shown in Fig. 4 to a closed position as shown in Fig. 5. The stop-rest 112, shown in detail in Fig. 7, is constructed with a hub 114 for embracing the rock-shaft extension 57, from which extends an arm 115 terminating in an offset end portion 116 to form a seat for the circuit-breaker supporting bracket 113. The stop-rest 112 is fixedly held in position on the rock-shaft extension 57 by means of a set-screw 117, as shown in Fig. 3. At the forward end of the offset portion 116 of its arm 115 is a pin 118 for connecting a spring 119 employed for a purpose as later explained.

The circuit-breaker supporting bracket 113, shown in detail in Fig. 8, comprises a hub portion 120 apertured as at 121 to embrace the shaft-extension 57 and having a laterally extending arm 122 adapted to overlie and engage the offset portion 116 of the stop-rest arm 115. The end of the arm 122 is apertured as at 123 to receive a set-screw 124 which engages the offset portion 116 of the stop-rest arm 115 to provide for adjusting the position of the supporting bracket 113 with respect to the stop-rest. The supporting bracket 113 is mounted free to turn on the shaft-extension 57 but is resiliently held in engagement with the stop-rest 112 by means of the spring 119 connected to a pin 125 at the outer end of its arm 122 and to the pin 118 on the arm 115 of the rest. By these connections both the stop-rest 112 which is fixed to the shaft-extension 57, and the supporting bracket 113 are rocked as a unit with the rock-shaft 52 during the normal operation of the machine. Formed integral with and positioned directly above the hub portion 120 of the bracket 113 is a platform 126 having threaded holes at 127 to receive the screws for two pairs of open-ended clips 128 that support the mercury switches 110 and 111. Projecting laterally from the end of the arm 122 is a pin 129 which is engaged by manually-operable means, to be later described, to rock the supporting bracket 113 to shift the circuit-breakers or switches to a closed position independently of the movement of the rock-shaft. Extending outwardly from the hub 120 below and angularly in relation to the arm 122 is a stop-arm 130 for engagement with the under side of the offset portion 116 of the stop-rest 112 to limit the rocking movement of the bracket 113 in a direction toward the right as viewed in Fig. 6. As shown in Figs. 3, 4, 5 and 6, the supporting bracket 113 carries a protecting hood 131 fastened thereto by screws 132 and 133 threaded into the hub 120 and the side of the arm 122. The supporting bracket 113 is held in place on the shaft-extension 57 by a collar 134 abutting the side of its hub portion 120.

The manually-operable means for tilting the supporting bracket 113 to close the switches are shown in Figs. 1, 3 and 6. A handle 136 projects from a casing 139 that encloses the machine and lies closely adjacent the end of the rock-shaft extension 57. The handle 136 has a shaft

138 that extends through a bearing plate 140 fixed to the casing 139 by means of screws 141. The handle 136 is formed with a flange 137 which abuts one side of the plate 140 and is held in position by the hub portion 142 of an arm 143 fixed to the shaft 138 by a set-screw 144 that abuts the opposite side of the plate. The arm 143 is positioned directly below the laterally extending pin 129 on the supporting bracket 113 to adapt it to engage therewith by turning the handle 136 whereby to rotate the supporting bracket 113 on the shaft-extension 57 to move it away from the stop-rest 112 against the action of the spring 119. This manually-operable means for the switches or circuit-breakers 110 and 111 is for the purpose of closing the circuit when it is desired to start the motor, at which time all three phase-windings must be energized.

Having now described the construction and arrangement of the various parts of the mechanism, the mode of operation of the winding machine and ribbon-breaker will next be explained. Referring to Fig. 1 of the drawings, the machine is prepared for winding by mounting a suitable wooden or fiber cone-tube or yarn-receiver C to rotate on the spindle 15. For this purpose the arm 16 is raised on its pivot and the spindle 15 swung outwardly on its swiveled joint at the outer end of the arm in accordance with the usual method. After the cop-tube C is in place the spindle 15 is swung back into position above the drive-roll 10 and the arm 16 lowered to bring the surface of the tube into driving contact with the periphery of the roll. The strand of yarn *y* or other material is led up from its source of supply through a tension-device, not herein illustrated, thence drawn across the periphery of the drive-roll 10 and its end attached to the cop-tube C in any suitable manner.

The housing 50 carrying the driving transmission is adjusted vertically to properly tension the belts 71 and 78 by loosening the nuts 43 on the ends of the stud-shaft 42, which allows the entire assembly of housing 50, rock-shaft 52 and brackets 37 and 38 to move downwardly. The weight of the assembly is such as to properly tension the belts by moving the housing 50 to its operating position. The nuts 43 are then tightened in position and the arms 58 and 59 adjusted by means of the screws 60 and 61 to engage and rigidly hold the housing 50 against lateral movement.

The operation of the machine is started by closing the motor starting switch 109, see Figs. 2, 9 and 10, while at the same time the phase-winding circuit-breakers 110 and 111 are closed by rotating the handle 136 in a clockwise direction, as viewed in Fig. 6, so that the arm 143 engages the laterally extending pin 125 to rock the frame 113 against the action of the spring 119. With all three windings in circuit the motor will automatically come up to its maximum speed and through the belts 102 will drive the shaft 55 in a clockwise direction. After the motor has attained its maximum speed the handle 136 is released so that the spring 119 will move the supporting bracket 113 into engagement with the stop-rest 112, whereafter the two elements will oscillate as a unit with the rock-shaft-extension 57. The parallel driving shaft 64 is driven in a counterclockwise direction by the shaft 65 through the intermeshing gears 72 and 79 fixed to the two shafts respectively. The shaft 11 carrying the drive-rolls 10 on one side of the machine is driven from the shaft 64 by the connecting belts 71 at the forward end of the housing, as viewed in Fig. 1.

Also, on the opposite side of the machine, as more clearly shown in Fig. 2, the shaft 13 carries a similar series of drive-rolls and cops which are prepared for winding, and this shaft 13 is driven directly from the driving shaft 65 through the belts 78 connecting the two shafts. From the above it will be apparent that the two gangs of drive-rolls 10 on opposite sides of the machine are driven by the motor and in opposite directions of rotation so that yarn may be supplied from either side of the machine.

As all the winding units operate in the same manner it will be sufficient to explain the mode of operation of one of them. The drive-roll 10 is rotated continuously and as the cop-tube C makes contact with its periphery it will be driven from the roll to wind on the yarn. As the yarn is taken up by the rotation of the cop-tube C the strand *y* enters the helical groove or grooves 8 and 9 on the periphery of the roll to be traversed thereby to deposit it on the receiver in helical coils which make several turns first in one direction and then in the opposite direction. In this way the yarn is given a continuous traverse from one end of the cop-tube to the other and back again to build up a succession of courses forming overlying layers which constitute the yarn body or package.

At the start of the winding the rotative speed of the cop-tube C will have a certain ratio to that of the drive-roll 10 depending upon their respective diameters and the yarn will be laid from end to end of the tube with a corresponding ratio in the number of coils to the number of turns in the grooves 8 and 9. As the yarn builds up on the cop-tube C the latter recedes from the drive-roll 10 and with the increase in diameter of the yarn mass its angular velocity or speed of rotation is gradually lessened, due to the increasing disparity between its diameter and that of the drive-roll. In other words, there is a constant change in ratio between the rotative speed of the package and drive-roll and, consequently, there will be a corresponding variation in the number of turns laid on the surface of the package, or in the "wind" as it is called.

At the start of the winding the yarn coils are laid in "open" or spaced relationship, but when the "wind" changes the spacing between the turns is lessened and the coils gradually close up and eventually tend to crowd together in bands or "ribbons". This crowding or piling of the yarn coils takes place each time the wind changes from a greater to a lesser number of even turns and ordinarily causes a "ribbon wind" on the surface of the package. When several coils are laid over each other in the "ribbon" they tend to slip and slide out of place and roll on the surface of the package. This disturbs the twist of the yarn and tends to weaken it so that its quality is impaired and, as another serious defect, the "ribbon" prevents the yarn from delivering freely when it is drawn off over the end of the package. The present invention operates to overcome this defect of "ribbon wind" in "drum-wound" packages by periodically varying the ratio between the rotation of the package and the traverse of the yarn thereon.

After the motor has attained maximum speed and the handle 136 has been released, the driving shaft 64 operates through the worm 73 and

worm-wheel 83 on the cam-shaft 80 to oscillate the rock-shaft 52 by means of its follower arm connection with the cam-groove 87. As the switches 110 and 111 are mounted on the supporting bracket 113 for oscillation as a unit with the rock-shaft extension 57 they will be continuously tilted from open to closed position. The switches 110 and 111, being in circuit with the phase-windings 105 and 106, will therefore alternately open and close the circuit windings to cause variations in the speed of the motor.

As shown in Fig. 4, the bracket 113 carrying the circuit-breakers 110 and 111 is tilted to shift the latter to open position, at which time the phase-windings 105 and 106 are open circuited as indicated in Fig. 9 and the motor operated on a single phase which causes a material reduction in its speed. When the rock-shaft 52 is rocked back in the opposite direction to shift the circuit-breakers or switches 110 and 111 to closed position as shown in Fig. 5 the phase-windings 105 and 106 are again connected in circuit with the source of current 108, thereby causing a sudden pick-up in the speed of the motor.

As the speed of the motor is alternately decelerated and accelerated, as above explained, a corresponding varied speed is transmitted to the drive-roll 10. This variation in the speed of the drive-roll has the effect to periodically vary the rate of traverse of the yarn following the helical groove or grooves on the roll. On the other hand, due to the momentum and inertia of the package during deceleration and acceleration, respectively, the peripheral speed of the package will be greater or less than the peripheral speed of the drive-roll so that its surface will slip or "skid" on the periphery of the roll and as a result thereof the synchrony of winding speed to yarn traverse is disrupted at frequent intervals to prevent ribbon winding. As an example, it has been determined that with the machine operating at a speed to wind 720 yards of yarn per minute, if the speed of the motor is decelerated and accelerated once for every 18 yards of yarn wound, or approximately 40 times per minute, ribbon winding is effectually eliminated. It also appears from observation of the machine in operation that the greatest effective slippage occurs between the drive-roll and the package during the acceleration in speed of the motor which is more rapid than the deceleration. It is to be understood, however, that the rate of the cyclic changes in the speed of the motor is capable of wide ranges of variation and that the invention is intended to include any change-speed motor capable of producing the desired results without limitation as to the example above referred to or to the slippage of the package that occurs only during acceleration.

To vary the effect of the slippage of the package on the roll the time periods during which the switches 110 and 111 are closed or open may be adjusted by the set-screw 124 to alter the angular position of the supporting bracket 113 on the shaft-extension 57. This adjustment may be made to effect any operative position between the extreme positions where the switches are constantly open or constantly closed whereby to vary the range of movement of the switches as desired.

Although the circuit-breaking mechanism has been shown in the drawings as applied to a three phase motor it is to be understood that the invention is not limited to the form shown and may be applied to either a direct or alternating current motor having single or multiple phase-windings, or an induction or repulsion type of motor having either a squirrel cage or wound type of rotor.

Although the phase-winding circuit-breakers have been illustrated and described as applied to a plurality of the windings, they can as well be applied to only one or to all of the phase-windings; or a single circuit-breaker may be used in circuit with a plurality of the phase-windings. Where a direct current motor is used the circuit-breaking mechanism may operate with a resistance winding to continuously or periodically vary the speed.

It will be observed from the foregoing description that the present invention provides for interrupting the synchrony in the ratio of winding speed to traverse of the yarn at recurring cycles by automatically altering the electrical characteristics of the driving motor to cause the latter to operate at rapidly fluctuating rates of speed.

It will also be apparent to those skilled in the art that various changes may be made in the form and type of apparatus employed. For example, other suitable types of circuit-breakers and operating means therefor may be used in place of those shown and described; and other types of motors in place of that illustrated. It will also be apparent that the present form of ribbon-breaker may be applied to winding machines of different type from that herein illustrated and described. Therefore, without limiting myself in this respect, I claim:

1. In a winding machine, the combination of means for rotatably supporting a package, means to rotate the package, means for traversing yarn on the package, a motor operatively connected to drive the package-rotating means, and automatically-operated control means for periodically increasing and decreasing the speed of the motor during the winding operation to interrupt the synchronism between the rotation of the package and the traverse of the yarn.

2. In a winding machine, the combination of means for rotatably supporting a package, means to rotate the package, means for traversing yarn on the package, a motor operatively connected to drive the yarn-traversing means, and automatically-operated control means for periodically increasing and decreasing the speed of the motor during the winding operation to interrupt the synchronism between the rotation of the package and the traverse of the yarn.

3. In a winding machine, the combination of means for rotatably supporting a package, means to rotate the package, means for traversing yarn on the package, an electric motor operatively connected with the package-rotating means, and current controlling means for periodically varying the speed of the motor to interrupt the synchronism between the rotation of the package and the traverse of the yarn.

4. In a winding machine, the combination of means for rotatably supporting a package, means to rotate the package, means for traversing yarn on the package, an electric motor operatively connected with the package-rotating means, and current controlling means actuated from the motor for periodically varying its speed to cause slippage between the package-rotating means and the package.

5. In a winding machine, the combination of means for rotatably supporting a package, means

to rotate the package, means for traversing yarn on the package, an electric motor operatively connected with the package-rotating means, and a periodically actuated circuit-breaker in the motor circuit for varying its speed to cause slippage between the package-rotating means and the package.

6. In a winding machine, the combination of means for rotatably supporting a package, means to rotate the package, means for traversing yarn on the package, an electric motor operatively connected with the package-rotating means, a circuit-breaker in the motor circuit, and means driven by the motor for periodically actuating the circuit-breaker to cause a variation in the speed of the motor to effect slippage between the package-rotating means and the package.

7. In a winding machine, the combination of means for rotatably supporting a package, a grooved drive-roll for rotating the package by peripheral contact therewith while acting to traverse the yarn longitudinally thereon, an electric motor operatively connected with the drive-roll, a circuit-breaker in the motor circuit, and means actuated by the motor for oscillating the circuit-breaker to alternately open and close the circuit whereby to vary the speed of the motor and cause slippage between the drive-roll and package.

8. In a winding machine, the combination of means for rotatably supporting a package, means to rotate the package, means for traversing yarn on the package, an electric motor operatively connected with the package-rotating means, a source of current for the motor, a tilting liquid-contact circuit-breaker in circuit with the motor and source of current, and means for oscillating the circuit-breaker to alternately open and close the motor circuit and cause slippage between the package-rotating means and the package.

9. In a winding machine, the combination of means for rotatably supporting a package, a grooved drive-roll for rotating the package by peripheral contact therewith while acting to traverse the yarn longitudinally thereon, an electric motor operatively connected with the drive-roll, a source of current for the motor, a tilting liquid-contact circuit-breaker in circuit with the motor and source of current, and means actuated from the motor for oscillating the circuit-breaker to alternately open and close the motor circuit whereby to vary the speed of the drive-roll.

10. In a winding machine, the combination of means for rotatably supporting a package, means to rotate the package, means for traversing yarn on the package, an electric motor for driving one of said means, said motor having a plurality of windings, and means for intermittently opening the circuit of one or more of the windings to vary the speed of the motor and the means driven thereby to change the ratio of package peripheral speed to traverse of the yarn thereon.

11. In a winding machine, the combination of means for rotatably supporting a package, a grooved drive-roll for rotating the package by peripheral contact therewith while acting to traverse the yarn longitudinally thereon, an electric motor for driving the drive-roll, said motor having a plurality of windings, and means for alternately opening and closing the circuit of one or more of the windings to decelerate and accelerate the speed of the motor.

12. In a winding machine, the combination of means for rotatably supporting a package and traversing yarn thereon, a driving-shaft for said means, an electric motor operatively connected with the driving-shaft, said motor having a plurality of windings, a circuit-breaker in the circuit of one or more of the windings, and means operated from the driving-shaft for alternately actuating the circuit-breaker to open and close the circuit and vary the speed of the driving-shaft.

13. In a winding machine, the combination of means for rotatably supporting a package and traversing yarn thereon, a driving-shaft for said means, an electric motor for rotating the driving-shaft, said motor having a plurality of windings, a cam actuated by the driving-shaft, a tilting liquid-contact circuit-breaker in circuit with one or more of the windings, and a lever operated by the cam for intermittently tilting the circuit-breaker to alternately open and close the winding circuit and vary the speed of the motor.

14. In a winding machine, the combination of a driving-shaft, an electric motor for rotating the driving-shaft, said motor having three phase-windings, circuit-breakers in circuit with two of the windings, and means operatively connected with the driving-shaft for alternately opening and closing the circuit-breakers to vary the speed of the motor.

15. In a winding machine, the combination of means for rotatably supporting a package and traversing yarn thereon, an electric motor for driving said means, said motor having a plurality of windings, a circuit-breaker in circuit with at least one of the windings, a rock-shaft for operating the circuit-breaker, and means operated from the motor for continuously oscillating the rock-shaft to alternately open and close the circuit-breaker and vary the speed of the motor.

16. In a winding machine, a frame, a driving-shaft journaled in the frame, a rock-shaft in the frame having a depending arm, a cam rotatably mounted in the frame and operatively connected with the driving-shaft, said cam engaging the arm to periodically oscillate the shaft, an electric motor for rotating the driving shaft, said motor having three phase-windings, and liquid-contact circuit-breakers in circuit with two of the windings, said circuit-breakers being actuated by the rock-shaft to open and close the said circuits to alternately decelerate and accelerate the speed of the motor.

17. In a winding machine, a driving shaft, a worm thereon, a cam-shaft, a worm-gear on the cam-shaft in mesh with the worm, a cam on the cam-shaft, a rock-shaft, a depending arm on the rock-shaft engaging the cam, an electric motor having multiple phase-windings, and liquid-contact circuit-breakers on the rock-shaft in circuit with two of the motor windings and operative to open and close the two winding circuits to vary the speed of the motor.

18. In a winding machine, the combination of means for rotatably supporting a package and traversing yarn thereon, a driving-shaft for said means, an electric motor for rotating the driving-shaft, a circuit-breaker in the motor circuit, means continuously operated by the driving-shaft for alternately opening and closing the circuit-breaker to vary the speed of the motor, and manually-operative means for maintaining the circuit-breaker closed.

19. In a winding machine, the combination of means for rotatably supporting a package and

traversing yarn thereon, a driving-shaft connected to drive said means, an electric motor for the driving-shaft, said motor having a plurality of windings, a tilting liquid-contact circuit-breaker in circuit with one or more of the windings, a rock-shaft for actuating the circuit-breaker, means actuated by the driving-shaft for continuously oscillating the rock-shaft to open and close the circuit-breaker and vary the speed of the motor, and manually-operative means for tilting the circuit-breaker to close the circuit to all of the windings to start the motor.

20. In a winding machine, the combination of means for rotatably supporting two series of yarn packages, two series of drive-rolls for rotating the packages, means for traversing yarn on the packages, a driving-shaft, means connecting the driving-shaft to rotate the two series of drive-rolls, an electric motor operatively connected with the driving-shaft and having a plurality of phase-windings, circuit-breakers in circuit with one or more of the phase-windings, and means for alternately opening and closing the circuit-breakers to decelerate and accelerate the speed of the motor and thereby the speed of the drive-rolls to prevent ribbon winding on the package.

21. In a winding machine, a frame, parallel shafts mounted on opposite sides of the frame, a plurality of drive-rolls on said shafts, a driving-shaft in the frame between the parallel shafts, means for driving the parallel shafts from the driving-shaft, an electric motor operatively connected with the driving-shaft and having a plurality of phase-windings, a circuit-breaker in circuit with one or more of the phase-windings, and means continuously operated from the driving-shaft for alternately opening and closing the circuit-breaker to vary the speed of the motor and thereby the speed of the drive-rolls to prevent ribbon winding on the package.

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