MATERIAL HANDLING CONTROL SYSTEMS

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ABSTRACT OF THE DISCLOSURE

Advancing wire passes over a plurality of pulleys which are interposed between a braked supply and a pulling device so that the wire follows a tortuous path of length L. Upon application of a momentary acceleration force to the material, at least two of the pulleys move to positions which shorten the length L, thus providing an excess of material between the supply and the pulling device to dampen the effect of the acceleration force.

This invention relates generally to material handling apparatus of the type wherein a continuous length of elongated material, such as wire, is advanced from a braked supply of the same by a pulling device. More particularly, this invention relates to control systems for use with such apparatus to dampen the effect of momentary acceleration forces which tend to elongate or break the material. Accordingly, the general objects of this invention are to provide new and improved apparatus of such a character:

One example of the use of the invention is in the manufacture of electron tube grids of the type including a helix of small gage wire (referred to as "lateral" wire) wound about two spaced, much larger gage support wires. Conventionally, the grids are manufactured by feeding the support wires in the direction of their lengths through grooves formed in opposed sides of a rotating mandrel. As the support wires rotateably advance they are alternately notched at uniform intervals by a notching wheel. The lateral wire is fed laterally to the support wires such that it enters the notches thereof, the notches then being peened by a peening wheel to secure the lateral wire to the support wires. The lateral wire is fed from a supply spool arranged to apply a constant back tension to the wire so that the helix is uniformly shaped.

After a number of turns, sufficient to constitute an individual grid, have been wound, the lateral wire is broken and the notching and peening wheels are withdrawn from their operative positions. The support wires continue to advance until unnotched portions of predetermined lengths are provided. (These portions later serve as the support legs for the grid just wound.) The notching and peening wheels are then returned to their operative positions whereupon the support wires are again notched. The extending end of the broken lateral wire then enters the first notch of the new grid and is peened into place.

One of the problems attendant to the "pickup" of the lateral wire is that, at that instant, the lateral wire is stationary; accordingly, an acceleration force is applied to the lateral wire which, in combination with the back tension applied therein, causes a resultant tensile force having a magnitude such as to elongate the wire by an excessive amount or to break the wire. Excessive elongation results in nonuniformity between grid turns, thereby adversely affecting the characteristics of the resultant tubes. Breaking of the lateral wire necessitates shutting down of the grid winding apparatus with the resultant loss of time and money.

It is, therefore, another object of this invention to provide new and improved control systems for use with grid winding apparatus of the foregoing type to prevent elongation or breaking of the lateral wire during winding thereof.

With the foregoing and other objects in view, a control system, illustrating certain features of the invention, may include a plurality of pulleys. The pulleys are interposed between a braked supply of elongated material and a pulling device so that the material extending between the supply and the pulling device follows a tortuous path around the pulleys of length L. Upon application of a momentary acceleration force to the material, at least two of the pulleys move to positions which shorten the length L, thus providing an excess of material between the supply and the pulling device to dampen the effect of the force. The pulleys then return to their initial positions to re-establish the length L.

The invention will be more readily understood from the following detailed description of a specific embodiment thereof, when considered in conjunction with the appended drawings wherein:

FIG. 1 is a fragmentary, isometric view, with parts removed and enlarged for the sake of clarity, of a portion of a grid-winding machine including a control system according to the invention for dampening the effect of momentary acceleration forces applied to lateral wire being wound therein;

FIG. 2 is a fragmentary, front elevation, with parts removed and enlarged for the sake of clarity, of the apparatus shown in FIG. 1; and

FIG. 3 is a diagrammatic view showing how the control system affects the feeding path of the lateral wire, the solid lines showing the control system when no acceleration force is applied to the wire and the dashed lines showing the control system during application of an acceleration force.

Illustratively, the invention will be described in connection with its use in an automatic grid winding machine.

GRID WINDING MACHINE

Referring now to the drawings, and particularly to FIGS. 1 and 2, the grid winding machine (i.e., as much thereof as is pertinent) includes an elliptical mandrel 10 having two longitudinal grooves 11—11 formed in opposite sides thereof through which two relatively large gage support wires 12—12 are advanced in the direction of their lengths. The mandrel 10 is rotated counterclockwise, as viewed in FIG. 2, by a motor (not shown), and the support wires 12—12 are advanced by a draw bar (not shown) rotated at the same speed as the mandrel. As the support wires 12—12 rotatably advance, a notching wheel 14 rotatably mounted beneath the mandrel 10 alternately forms notches 16 in the wires at uniform intervals.

Relatively small gage lateral wire 17 is fed laterally to the rotatably advancing support wires 12—12 at a longitudinal position slightly offset to the left of the notching wheel 14, as viewed in FIG. 1. When a notch 16 is aligned with, and reaches the lateral wire 17, the wire drops into the notch. The notch 16 is then peened or swaged by a peening wheel 18 rotatably mounted above the mandrel 10 in the same vertical plane as the lateral wire 17 to secure the lateral wire to the support wire 12.

The lateral wire 17 is fed from a supply spool 19 mounted on the shaft of a tensioning device 21, such as a hysteresis brake, which applies a constant back torque to the spool during rotation thereof so that the lateral wire is wound with a constant back tension applied thereto. This assures that the grid turns are of a uniform shape.

From the supply spool 19, the lateral wire 17 is fed to a control system 22 (to be described in detail below), and
then to a pulley 23 rotatably supported by a bracket 24 mounted on a horizontal base plate 26. The lateral wire 17 is then fed beneath a first wire guide 27, between a pair of jaws 28 and 29, beneath a second wire guide 31 and to the rotatably advancing support wires 12—12. The jaw 28 is stationary while the jaw 29 is mounted for pivotal motion about a pivot pin and lever 33 pivotally secured to the base plate 26 and provided for pivoting the jaw 29, pivoting of the lever being controlled by a solenoid 34. When the solenoid 34 is energized, the shaft 36 is extended, causing the lever 33 to pivot clockwise, as viewed in FIG. 1. This, in turn, causes the jaw 29 to pivot counterclockwise to clamp the lateral wire 17 between the jaws. Upon de-energization of the solenoid 34, the shaft 36 retracts whereupon the jaw 29 and lever 33 are returned to their initial positions under the urging of a compression spring 37 connected between the jaws 28 and 29.

The solenoid 34 is operated each time a predetermined number of turns of lateral wire 17 (constituting an individual grid) have been wound. Each time the solenoid 34 is operated the jaws 28 and 29 clamp the lateral wire 17. The support wires 12—12, however, continue to rotate as before, whereby the lateral wire breaks at the notch 16 in alignment with the lateral wire at the time of clamping, due to the combined action of the clamping force and the shearing force exerted on the wire by its sliding engagement with the notch.

The notching and peening wheels 14 and 16 are moved out of their operative positions by suitable means (not shown) so as to enable formation of unnotched, unwound portions 38—38 of the support wires 12—12 to serve as support legs for the grid just wound. After the support wires 12—12 have advanced a sufficient distance to provide the requisite unnotched portions 38—38, the notching and peening wheels 14 and 16 moved back into their operative positions. As the first notch 16 formed after return of the notching wheel 14 to its operative position reaches the broken end of the lateral wire 17 extending from the jaws 28 and 29, the wire drops therein. The notch 16 is then peened, causing a momentary acceleration force to be exerted on the lateral wire 17 which, in combination with the applied back tension to the wire would cause excessive elongation or breaking thereof were it not for the control system 22.

CONTROL SYSTEM

As will be seen below, the control system 22, in accordance with the instant invention, functions to cause absorption of any momentary acceleration of the momentary acceleration force (resulting from the “pickup” of the lateral wire 17) in a manner such that the effect thereof is minimized to the extent that no elongation or breaking of the lateral wire takes place.

The control system 22 includes first and second pulleys 39 and 41 rotatably mounted on respective angularly depending legs 42 and 43 of a support arm 44 pivotally mounted on a vertical post 46. A third pulley 47 is rotatably mounted on the post 46 below the support arm 44. As is readily seen, the lateral wire 17 is fed upwardly from the supply spool 19 to and over the first pulley 39, then downwardly to and beneath the third pulley 47, then upwardly to and over the second pulley 41 and then downwardly to and beneath the pulley 23, from which it is fed to the rotatably advancing support wires 12—12.

Upon application of a momentary acceleration force to the system that resulting during each pickup of the wire, for example), the support arm 44 pivots in a clockwise direction. This results in a shortening of the feeding path of the lateral wire. This, in turn, results in an excess of lateral wire 17 between the supply spool 19 and the mandrel 10 which absorbs or dampens the pickup of the lateral force causing it to move vertically to and thereby shortening the feeding path of the lateral force (from ABCDE to A'B'C'D' E) to provide an excess of wire to dampen the effect of the force such that no elongation or breaking of the wire occurs. The support arm 44 is then returned to its original position in readiness to cause a dampening of the momentary acceleration force resulting during the next pickup of the lateral wire 17. The above procedure is repeated until the draw bar advancing the support wires 12—12 reaches the limit of its travel, whereupon cutters...
(not shown) cut the support wires. The machine is then reset to wind another "stick" of individual grids.

It is to be understood that the above-described embodiment is illustrative of the principles of the invention. Other embodiments may be devised by persons skilled in the art which embody these principles and fall within the spirit and scope thereof.

What is claimed is:

1. In combination with material handling apparatus of the type wherein a continuous length of elongated material is advanced from a braked supply of the same by a pulling device; a control system for dampening the effect of momentary acceleration forces, which comprises: a plurality of spaced, rotatable pulleys positioned so that the material passes a portion of the periphery of each pulley as it advances from the supply to the pulling device; the pulleys being further positioned so that the material extending between the supply and the pulling device follows a tortuous path around the pulleys of a length L; and means mounting two of the pulleys for rotation in the same direction and for synchronous shifting movement relative to a third intervening pulley rotating in an opposite direction, said shifting movement being dictated by the tension in the material at any time, the movable pulleys being so arranged with respect to each other that, upon application of a momentary acceleration force to the material, the movable pulley positions which shorten the length L, thus providing excess material between the supply and the pulling device to dampen the effect of the force, and then return to positions re-establishing the length L.

2. In combination with material handling apparatus of the type wherein a continuous length of elongated material is advanced from a braked supply of the same by a pulling device; a control system for dampening the effect of momentary acceleration forces, which comprises: a pivotably mounted support arm; first and second pulleys rotatably mounted on the support arm; a fixed support; and a third pulley rotatably mounted on the fixed support; the pulleys being interposed between the pulling device and the supply such that the material is fed from the supply to the first pulley, then to the third pulley, then to the second pulley and then to the pulling device; and being so arranged that, upon application of a momentary acceleration force to the material, the support arm first pivots in one direction to shorten the feeding path from the supply to the pulling device so as to provide excess material therebetween to dampen the effect of the force, and then pivots in the opposite direction to return the first and second pulleys to their initial position.

3. Apparatus according to claim 2, wherein the support arm includes two relatively divergent legs with the first pulley rotatably mounted on one leg and the second pulley rotatably mounted on the other leg.

4. Apparatus according to claim 2, wherein the pulleys are disposed in a vertical plane with the first and second pulleys rotatably mounted on the support arm so that they are equally spaced from the pivot point thereof, and wherein the third pulley is mounted vertically below the pivot point.

5. Apparatus for winding elongated material in a manner such that the material does not further elongate or break upon application of momentary acceleration forces thereto, which comprises: a supply spool for the elongated material rotatably mounted such that a back torque opposing the direction of motion of the spool is exerted thereon when the spool is rotated; means for winding the material from the supply spool; a pivotably mounted support arm; first and second pulleys rotatably mounted on the support arm; a fixed support; and a third pulley rotatably mounted on the fixed support; the pulleys being interposed between the winding means and the supply spool such that the material is fed from the supply spool to the first pulley, then to the third pulley, then to the second pulley and then to the winding means; and being so arranged that, upon application of a momentary acceleration force to the material, by the winding means, the support arm first pivots in one direction to shorten the feeding path from the supply to the winding means so as to provide excess material therebetween to dampen the effect of the force, and then pivots in the opposite direction to return the first and second pulleys to their initial position.

6. Apparatus according to claim 5, wherein the pulleys are rotatably mounted on the support arm in opposite sides of the pivot point thereof, and the support arm is shaped such that the pivot point is offset from a line passing through the centers of the pulleys.

7. In a winding machine for winding a lateral wire about a pair of spaced support wires in a manner so as to form a plurality of spaced, individual helical grids, and including means for attaching the lateral wire to the support wires and means for breaking the lateral wire after formation of each individual grid, the improvement of means for feeding the lateral wire to the support wires so that the lateral wire is wound at constant applied back tension and does not elongate or break upon each re-attachment thereof to the support wires, which feeding means comprises:

a supply spool for the lateral wire rotatably mounted such that a constant back torque opposing the direction of motion of the spool is exerted thereon when the spool is rotated, a constant back tension thereby being applied to the lateral wire during winding thereof;

a vertical post;
an inverted, substantially U-shaped support arm pivotally mounted on the post;
a first pulley rotatably mounted on one of the legs of the support arm;
a second pulley rotatably mounted on the other leg of the support arm;
a third pulley rotatably mounted on the post beneath and on the same vertical axis as the pivot point of the support arm;

the post being interposed between the rotatably advancing support wires and the spool such that the wire is fed from the supply upwardly to and over the first pulley, then downwardly to and beneath the third pulley, then upwardly to and over the second pulley and then downwardly to the support wires; and such that upon each re-attachment of the lateral wire, the support arm first pivots in one direction to shorten the feeding path from the supply spool to the support wires so as to provide excess wire therebetween to dampen the effect of the momentary force exerted on the wire during re-attachment, and then pivots in the opposite direction to return the first and second pulleys to their initial positions.

8. Apparatus according to claim 2, wherein said pivotably mounted support arm and said fixed support positions said pulleys to respond to an increase in tension exerted on said material by positioning said arm to decrease the length of advancing material between said third pulley and said pulling device by an amount which is greater than the amount of increase in length of material advancing from said braked supply to said third pulley.

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