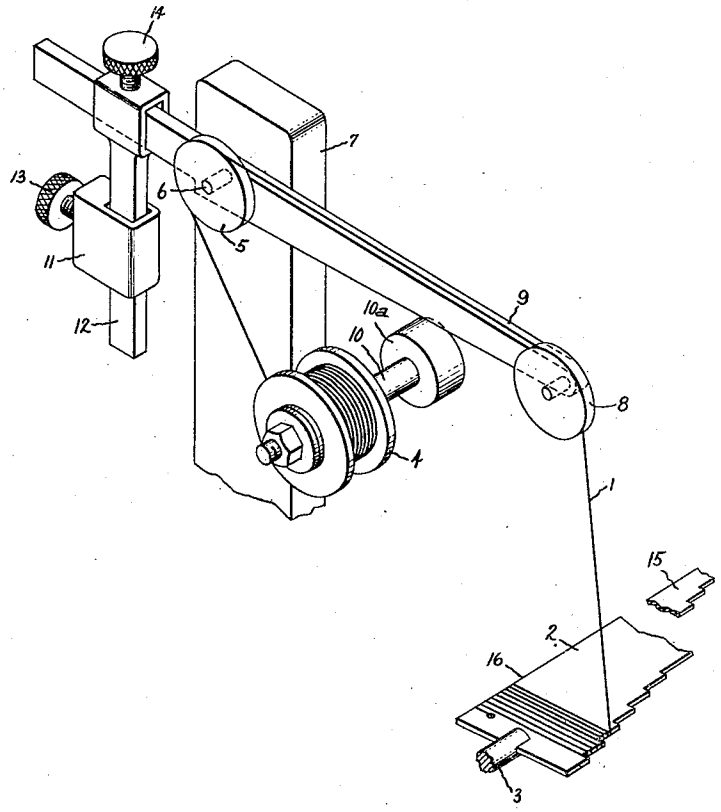
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TENSION ARM

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TENSION ARM

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1 Claim. (Cl. 242—45)

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This invention relates to winding machines, more specifically to means for maintaining a predetermined tension in the wire as it is fed to the support on which it is being wound and has for its object simple and reliable means for maintaining a predetermined tension uniformly while the wire is fed at nonuniform and high speeds or momentarily reversed in the winding of the wire on supports of irregular shape.

This invention has particular application to machines for winding fine wire into precision electric resistances on supports or cards of rectangular strips of insulating material, the amount of resistance of which included in an electric resistance is varied in accordance with a linear or nonlinear function of the movement of an electric contact removable over bared turns on one edge of the card. As these cards are rotated on the winding machine and the wire wound in them, the speed of the wire is nonuniform, varying in accordance with a complex sine function. Moreover the wire speed may momentarily drop to zero, or may reverse with reverse movement of the wire. When the wire is fed directly from the wire supply reel and its associated tension-producing means, uniform tension can be maintained only at very low winding speed because of the inertia of the supply reel and tension-maintaining means. By passing the wire over a pulley mounted on a cantilever spring the speed can be increased somewhat, but when a critical speed is reached undamped oscillations occur in the pulley with resulting breakage of the wire. Moreover, the tension in the wire is nonuniform and reaches values in excess of the yield point of the wire resulting in significant adverse changes in wire electrical properties including unit resistance.

In carrying out our invention in one form we pass the wire over a pulley mounted on the end of an arm having a counterweight on its other end. This counterweight is adjustable along the arm to provide the required tension and also adjustable in a direction at right angles to the arm in the plane of movement of the arm to prevent oscillation of the arm at high speeds.

For a more complete understanding of our invention, reference should be had to the accompanying drawing, the single figure of which is a fragmentary view in perspective of a winding machine embodying our invention.

Referring to the drawing, the wire 1 is being wound on a support or card strip 2 made of electrically insulating material suitably secured for rotation to a shaft 3. The shaft 3 is turned at a

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suitable speed as by an electric motor (not shown). From a supply reel 4 the wire passes over a pulley 5 mounted on a pivot pin 6 secured to a support 7 and then over a guide pulley 8 on the end of a straight tension arm 9 pivoted on the pin 6. Suitable wire tension-maintaining means is connected to the shaft 10 on which the reel 4 is secured, which tension means may be an electric torque-motor 10a, or a drag element of the hydraulic, magnetic or friction type.

For the purpose of counterbalancing the arm 9, we provide a weight 11 adjustably mounted on an arm 12 which, in turn, is adjustably mounted on the arm 9 on the side of the pivot 6 opposite the pulley 8. As shown, the weight 11 is secured in an adjusted position on the arm 12 by a clamping screw 13 and the arm 12 is secured at its upper end in adjusted position on the arm 9 by means of a clamping screw 14. As shown, the arm 12 extends downward from the arm 9 at right angles thereto and to the pivot 6 and in the plane of movement of the arm 9. The combination of weight 11 and arm 12 may be characterized below as a counterweight device.

Prior to the actual winding of a card but with the wire attached to the card 2, the arm 12 with the weight 11 secured thereto is adjusted along the arm 9 with the torque motor applying the desired tension to the wire until the arm 9 is horizontal and the arm 12 secured in position by the screw 14. Then the card is rotated at the maximum desired winding speed and, while thus winding wire, the weight 11 is adjusted along the arm 12 until the swing of the arm 9 is uniform for each card revolution and no inertia shock can be felt in the pin 6. It will be noted that adjustment of the weight on arm 12 varies the distance of the weight from the pivot 6 and, therefore, varies the inertia damping effect of the weight. Moreover, when the arm 9 is moved counterclockwise, the pulley 8 moving upward, by the counterbalancing weight 11 momentarily to take up slack in the wire, the weight 11 moves downward and inward toward a vertical plane passing through the axis of the pivot 6 for reduction in the counterbalancing effect of the weight and, therefore, reduced tension in the wire. When the arm 9 is moved clockwise in response to a momentary increase in wire tension, the opposite effect occurs, the weight 11 moving outward to increase its counterbalancing effect and increase the wire tension. In each case, the variation in the effectiveness of the counterbalancing weight is in a direction to reduce the swing of the arm 9 and, therefore, in-

duce the return of the arm 9 back to the horizontal position. We have found that the offset position of the weight 11 with respect to the arm 9 causes the weight to absorb tension shocks in the wire to permit acceleration and deceleration of the reel 4 by the wire during the winding operation with wire tensions below the elastic limit of the wire. In a typical machine provided with our invention a nickel-chromium-iron wire having a diameter of .00225 inch has been wound at speeds of 200 R. P. M.

It will be understood that in a complete winding machine the guide pulley 8 is moved along the axis of the shaft 3 at such speed as properly to space the wire turns on the card 2. Preferably, the support 7 is thus moved. Such a machine is described and claimed in a copending application, Serial Number 664,471, filed on April 24, 1946 by John R. Moore for "Variable Resistor Winding Machine" and assigned to the same assignee as this invention.

Reverse movement of the wire, i. e., the wire is retrieved momentarily upon each turn of the card 2 when one end or a portion of the card lies wholly on one side of the axis of rotation of the card, as illustrated by the portion 15 of the card 2. The shape of the card 2 is governed by the desired resistance variation function as an electric contact (not shown) is moved over bared turns on the straight edge 16 of the card.

While we have shown a particular embodiment of our invention, it will be understood, of course, that we do not wish to be limited thereto since many modifications may be made and we therefore contemplate by the appended claim to cover any such modifications as fall within the true spirit and scope of our invention.

What we claim as new and desire to secure by Letters Patent of the United States is:

A tension device for a wire-winding machine comprising a wire-tension arm, a pivot supporting said arm at an intermediate point thereof, a first wire-guide pulley on one end of said tension arm, a second wire guide pulley mounted on said pivot, a wire-supply reel, wire-tension means connected to said reel for maintaining a predetermined tension in a wire supplied from said reel over said pulleys, a counterweight device adjustably positionable on said tension arm on the side of said pivot opposite said first pulley for selection of desired static tensions, said counterweight device including a downwardly extending second arm having a counterweight vertically adjustably positionable thereon for selection of desired tension variation characteristics as a function of angular displacement of said wire-tension arm.

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