April 27, 1926. **A. H. ADAMS** 1,582,023

STRAND WORKING MECHANISM

Filed Oct. 7, 1924

Fig. 1

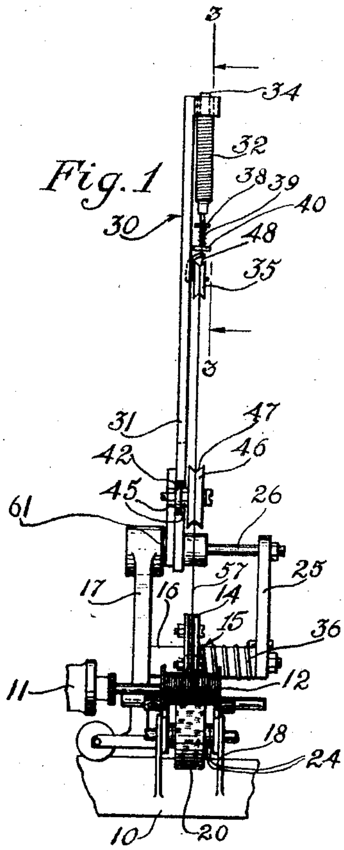


Fig. 2

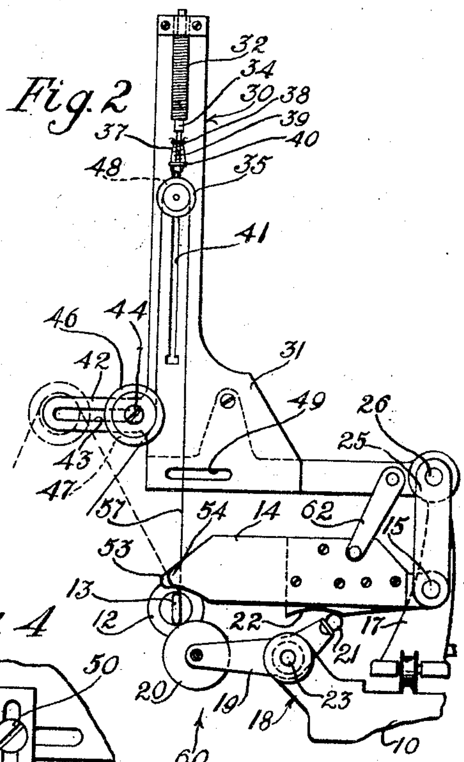


Fig. 4

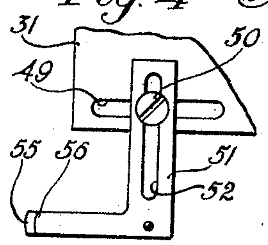


Fig. 3

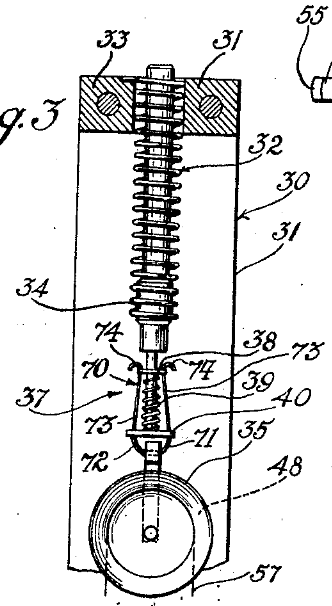
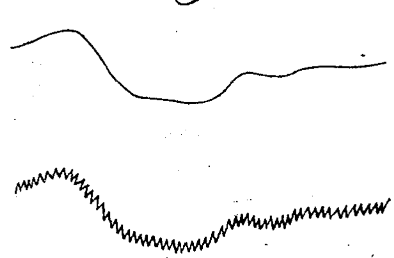


Fig. 5



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UNITED STATES PATENT OFFICE.

ARTHUR HERMAN ADAMS, OF LA GRANGE, ILLINOIS, ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

STRAND-WORKING MECHANISM.

Application filed October 7, 1924. Serial No. 742,107.

To all whom it may concern:

Be it known that I, ARTHUR HERMAN ADAMS, a citizen of the United States, residing at La Grange, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Strand-Working Mechanisms, of which the following is a full, clear, concise, and exact description.

This invention relates to strand working mechanisms, and more particularly to improvements in tension regulating devices therefore.

In winding strand material on spools having cores of non-circular cross-section, such as elliptical or rectangular cores, it has been found that various intermittent stresses are imposed on the strand material due to the rotating non-circular core alternately slackening and then jerking the strand, this alternative action being produced by the narrowest side of the core withdrawing strand material less rapidly from the supply source than the widest side thereof.

When winding cores at high speeds, such as 10,000 R. P. M., the ordinary type of resilient tension regulating device does not compensate for these intermittent stresses due to the rapidity with which they take place; the period of vibration of the spring of the tension regulating device being comparatively greater than the period of the stresses and hence the spring cannot react to compensate for them.

It is desirable in winding such cores that these intermittent stresses be eliminated, inasmuch as they cause strains and stretching of the wire and of the insulation, where the wire is insulated, and in cases where an enamel insulation is employed these stresses tend to crack or seriously damage the enamel insulation, especially at those points where the radius of the core is least. Another, and serious effect of these stresses or jerks, is that they cause a greatly increased average tension on the wire and thus build up much higher pressures between layers than occur in spools having circular cores. A further objectionable effect is that the stretching hardens and thus increases the resistivity of the wire materially, making the use of the copper less efficient. In general, these intermittent stresses affect the uniformity with which the spool is wound and the electrical qualities of the spool.

An object of this invention is to provide in a strand working mechanism an improved tension regulating device for minimizing deleterious stresses on the strand material.

To these ends a tension regulating device made in accordance with this invention consists of a pulley of very small mass mounted on a light weight hanger suspended on a compression spring of comparatively small mass and having short periods of vibration. The spring is carried by a member of relatively great mass as compared with the spring and hanger, which member may take the form of a plunger. The plunger is in turn supported and surrounded by a very flexible tension spring having relatively long periods of vibration. The flexible tension spring is adapted to compensate for larger and slower variations in tension, such as those caused by acceleration or deceleration of the machine or of the supply spool, and the compression spring having short periods of vibration is adapted to compensate for the sudden irregularities in tension caused by the rotation of a non-circular type core.

Another feature of the invention is the provision of mechanism for stepping back the reciprocating distributor from the core as it is wound, but always maintaining it in proximity to the core.

Other objects and advantages of the invention will more fully appear from the following detailed description taken in connection with the accompanying drawings which illustrate one embodiment thereof, and in which:—

Fig. 1 is a front view of the tension regulating device and the stepping back mechanism applied to a winding machine which is shown fragmentarily;

Fig. 2 is a side elevation of the structure shown in Fig. 1;

Fig. 3 is an enlarged detail view of a portion of the tension regulating device as shown in Fig. 2;

Fig. 4 is an enlarged detailed view partly in section showing a modified type of distributor arm, and

Fig. 5 is a graphical representation of the reactions of the two springs of the tensioning device while in operation.

Referring now to the drawings in detail in which like reference numerals designate similar parts throughout the several views, 10 denotes the frame of the winding machine on which is suitably supported a winding spindle 11 (Fig. 1). The winding machine may be of any suitable or usual type but the improved tension regulating device and the stepping back mechanism to be hereinafter described are particularly designed for use with the type of winding machine disclosed in my Patent No. 1,117,620, dated November 17, 1914. Mounted on the winding spindle 11 is a spool 12 having a non-circular or elliptical type of core 13 (Fig. 2) which may be held in place thereon by any suitable means (not shown). Positioned immediately over and in proximity to the core 13 is a distributor 14 which is pivotally mounted at point 15 to an arm 16 (Figs. 1 and 2) projecting at right angles from an arm 17 which may be carried by a reciprocating carriage (not shown). Pivotally mounted to an arm 18, projecting from the frame 10, is a bell crank lever 19 (Fig. 2), on one end of which is rotatably mounted a cork roller 20 and on the other end is mounted a pin 21 which is adapted to ride in a cam-like groove 22 in the lower portion of the distributor 14.

The cork roller 20 is positioned immediately below and rides against the core 13 of the spool 12. Pivot point 23 of the lever 19 is provided with a plurality of cork washers 24 which frictionally engage the lever 19 and which act as a drag thereon, preventing the cork roller 20 from being moved out of its close relation to the spool 13. Surrounding one end of the arm 16 is a spring 36, one end of the spring being secured to a link 25 and the other end being secured to the distributor 14, which functions to prevent the distributor 14 from being moved out of close relation to the core 13 of the spool due to any irregularities caused by the cork roller 20 riding on the core. The link 25 extends from the arm 16 and with arm 17 supports a shaft 26 carrying frame 31 of the tension regulating device denoted generally by reference character 30.

Tension regulating device 30 consists essentially of a very flexible tension spring 32 (Fig. 3) suitably secured at one end to the extremity of the frame 31 as indicated at point 33 and at the other end to a plunger 34 which passes through the spring 32, a small grooved pulley 35 of very light mass, a very light weight hanger denoted generally by reference character 37 for supporting the pulley 35, and a less flexible compression spring 39, interposed between a ring 38, formed on the plunger 34, and the enlarged end 40 of the plunger 34. The hanger 37 comprises a yoke 70 formed of wire bent into a substantially U-shape, the bottom of the U-shaped yoke forming a stirrup 71 carrying a member 72 which rotatably supports the pulley 35. The legs 73 of the yoke 70 are threaded through diametrically opposed slots in the enlarged end 40 of the plunger 34 and through diametrically opposed apertures in the ring 38 formed on the plunger 34; the tips of the legs being bent to form hooks 74, thereby supporting the yoke 70. It will be noted that the back of the member 72 rides in a slot 41 in the frame 31 (Figs. 1 and 2) which permits the pulley 35 to move up and down freely and also prevents the pulley from being moved out of the vertical path in which it travels.

The pulley 35 may be made of any suitable light material such as "phenolized linen" celluloid, or the like. Preferably, the pulley herein disclosed is made by molding a star-shaped bearing in disks of "phenolized linen."

The spring 32 is very flexible so as to enable it to respond readily to all the large and slower variations in tension on the material being wound, and to thereby prevent the material from stretching or breaking. In order to attain this flexibility, the spring 32 has a comparatively large number of turns of wire giving it a relatively long period of vibration, and hence it is unable to compensate for the rapid intermittent vibrations in tension on the material being wound, inasmuch as the period of these variations in tension is considerably less than the period of vibration.

The spring 39 is designed to respond to the high frequency variations in tension and has a short period of vibration. To have such a period the wire of the spring 39 is comparatively short as compared to its diameter, which means that it must be composed of relatively few turns of wire; the size of the wire and the mass of the hanger and supported pulley must be chosen to give at least the desired natural period. It will be noted that since spring 39 has fewer turns of wire it will necessarily have less flexibility, and hence will not respond to the large and slower variations in tension.

In the tension regulating device disclosed herein, it has been found that satisfactory results are attainable with a pulley 35 of .28 grams, a hanger 37 of .27 grams and a small spring 39 of .06 grams.

Extending from one side of the frame 31 of the tensioning device 30 is an arm 42 (Fig. 2) having a slot 43. Riding in this slot 43 is a bolt 44, secured therein by a pair of lock nuts 45 (Fig. 1), on which is rotatably mounted a grooved pulley 46. It will be noted, referring to Fig. 2, that the groove 47 of the pulley 46 is in alignment with the groove 48 of the pulley 35.

In the lower part of the frame 31 of the tensioning device 30 is a slot 49 which is adapted to carry a bolt and nut 50 (Fig. 4) on which may be mounted a distributor 51 (Fig. 4) which may be used in place of distributor 14 whenever the particular spool being wound does not require the distributor to be maintained at all times in proximity with the core of the spool. This distributor 51 has a slot 52 which makes it possible not only to adjust the distributor 51 in a horizontal plane but also to enable the adjustment thereof in a vertical plane.

The entire distributing mechanism, including both the tension regulating device 30 and the distributor 14, are adapted to be reciprocated the length of the core of the spool by any suitable means (not shown).

The distributor 14 is composed of two fingers 53 and 54 (Fig. 2) and likewise the distributor 51 is composed of two fingers 55 and 56 (Fig. 4). Figure 53 is longer than finger 54 and finger 55 is longer than finger 56, which arrangement facilitates the placing of the strand 57 (Fig. 2) between the distributing fingers.

The operation of the mechanism is as follows: The strand 57 is fed from a usual supply source (not shown) under the pulley 46 through the groove 47 thereof to and over the pulley 35 thence between the distributing fingers 53 and 54 of the distributor 14 which applies the strand to the revolving spool (Fig. 2).

As the strand is wound onto the spool the cork roller 20 is moved downwardly which causes lever 19 to pivot thereby resulting in pin 21, on the other end of lever 19, gradually moving the distributor away from the spool being wound. The cam-like groove 22 may be computed mathematically so as to maintain a constant relative movement between the distributor 14 and spool 12 as it is being wound.

The larger and slower variations in tension, such as those imposed on the strand 57 upon starting the winding mechanism, are compensated for by the spring 32. The small and rapid variations in tension, principally those imposed on the strand by the rotation of a non-circular or elliptical shaped core, are compensated for by the less flexible spring 39, inasmuch as the mass of the pulley 35, the hanger 37 and the small spring 39 is less than that of the large spring 32 and plunger 34 and since the period of time during which these variations take place is very short. In other words the rotation of the non-circular core being comparatively rapid, these small variations in tension are not great enough to overcome the inertia of the large spring 32 and associated plunger 34 and hence must react on the small spring 39.

Especially noteworthy is the fact that the tension regulating device 30 and the stepping back mechanism, denoted generally by reference character 60, may be used separately or together.

By applying the distributor 51 as shown in Fig. 4 to the groove 49 of the frame 31 and removing the stepping back mechanism 60, the tension regulating mechanism 30 may be used by itself.

By moving the pulley 46 outwardly in slot 43 and passing the strand over said pulley 46 thence to the distributor 14, as shown by the dotted lines in Fig. 4, the stepping back mechanism 60 may be used by itself. It will be noted that the drawings (Fig. 2) show the tension regulating device 30 and the stepping back mechanism 60 in use together and the stepping back mechanism 60 in use by itself.

When the spool 12 has been filled the operator pushes the tension regulating device 30 upwardly, causing it and shaft 26 to turn in the arm 17 at point 61 (Fig. 1) and through the link 62 (Fig. 2) causing distributor 14 to pivot at point 15 upwardly enabling the spool to be easily and readily removed from the spindle 11.

In order to more clearly illustrate the variations in tension an apparatus embodying the features of the invention was built with small pins soldered to points A, on the plunger 34, and B on the end of hanger 37, respectively. A smoked chart or plate was then passed over these points while the mechanism was in operation. The graph shown in Fig. 5 represents a portion of the variations in tension registered on the smoked chart. It is apparent that when a circular core is being wound a chart taken in the aforesaid manner would show substantially only two parallel lines but when a non-circular type core is being wound a chart taken in the aforesaid manner will not show two parallel lines, the lower line showing in addition to the large variations the slight variations in tension, caused by the rotation of the non-circular core, which are compensated for by the small spring 39.

The tension regulating device herein disclosed is particularly advantageous in winding non-circular type cores such as flat, square or elliptical shaped cores, but it is to be understood that this device may be used with advantage in winding any type of core, inasmuch as it tends to minimize stresses imposed upon the strand material being wound. By using this tension regulating device and thus minimizing stresses upon the material, the core being wound can more easily meet the electrical requirements. Furthermore, when enameled wire is being wound, this tension regulating device greatly minimizes the stretching of the wire and hence the cracking of the insulation. By so doing the number of short circuits in the wound spool is minimized and the spool is enabled to more easily meet much finer electrical requirements than heretofore.

The stepping back mechanism herein disclosed enables the material to be wound on the spool much more uniformly, inasmuch as the distributor is at all times maintained in proximity to or at a constant distance from the wound strand on the core thereby minimizing the play in the strand being wound.

What is claimed is:

1. In a tension regulating device for strand working mechanism including means for advancing a strand, a pair of elements co-operating to regulate the tension in the strand and responsive in different degrees to a force tending to compress one of them and to expand the other.

2. In a tension regulating device for strand working mechanisms including means for advancing a strand, a pair of interconnected elements for regulating the tension in the strand, one of the elements having great flexibility and the other having comparatively less flexibility, the elements being responsive in different degrees to the tension imposed on the strand.

3. In a tension regulating device for strand working mechanisms including means for advancing a strand, a flexible element having a comparatively long period of vibration and an associated element of less flexibility having a comparatively short period of vibration, said elements being responsive in different degrees to the tension imposed upon the strand and compensating for variations in tension, thereby regulating the tension in the strand.

4. In a tension regulating device for winding mechanisms for winding a strand upon a non-circular type core, resilient means for compensating for the variations in tension of one character imposed upon the strand, and other resilient means for compensating for the variations in tension of another character imposed upon the strand by the rotation of the non-circular type core, said means co-operating to regulate the tension in the strand.

5. In a tension regulating device for winding mechanisms for winding a strand upon a non-circular type core, a spring of great flexibility having a comparatively long period of vibration, for compensating for the variations in tension of one character imposed upon the strand, and a spring carried thereby of lesser flexibility having a comparatively short period of vibration for compensating for the variations in tension of another character imposed on the strand by the rotation of the non-circular type core, said spring co-operating to regulate the tension in the strand.

6. In a tension regulating device for winding mechanisms for winding a strand upon a non-circular type core, an element engaged by the strand and two interconnected springs for resiliently supporting the said element, one of the springs compensating for the variations in tension of one character imposed upon the strand and the other spring compensating for the variations in tension of another character imposed upon the strand by the rotation of the non-circular type core.

7. In a tension regulating device for winding mechanisms for winding a strand upon a non-circular type core, a pulley of very small mass and two interconnected springs for resiliently supporting the said pulley, one of the springs compensating for the variations in tension of one character imposed upon the strand and the other spring compensating for the variations in tension of another character imposed upon the strand by the rotation of the non-circular type core.

8. In a tension regulating device for strand working mechanisms, a pulley of very small mass, a spring of relatively little flexibility and having a comparatively short period of vibration for supporting the said pulley, an element of relatively great mass which supports the said spring, and a second spring of relatively great flexibility and having a comparatively long period of vibration which supports the element of great mass.

9. In a tension regulating device for strand working mechanisms including means for advancing a strand, a plurality of resilient means associated with the strand and regulating the tension thereon and selectively compensating for variations of different characters in tension imposed on the strand.

10. In a tension regulating device for strand working mechanisms including means for advancing a strand, a resilient means responsive to variations of one character and non-responsive to variations of another character in tension on the strand, and another resilient means responsive to variations of the latter character, said resilient means co-operating to regulate the tension in the strand.

11. In a tension regulating device for strand working mechanisms including means for advancing a strand, a resilient means responsive to variations of one character and non-responsive to variations of another character in tension on the strand, and another resilient means responsive to variations of the latter character, said resilient means co-operating to regulate the tension in the strand and non-responsive to variations of the first mentioned character.

12. In a tension regulating device for

strand working mechanisms including means for advancing a strand, a resilient means responsive to variations within a predetermined range of frequencies in tension on the strand, and another resilient means responsive to variations having frequencies outside the predetermined range, said resilient means co-operating to regulate the tension in the strand.

13. In a tension regulating device for strand working mechanisms including means for advancing a strand, a resilient means responsive to variations within a predetermined range of amplitudes in tension on the strand, and another resilient means responsive to variations of amplitudes outside the predetermined range, said resilient means co-operating to regulate the tension in the strand.

14. In a tension regulating device for strand working mechanisms including means for advancing a strand, a plurality of resilient means for regulating the tension in the strand, individually responsive to and compensating for variations of different degrees in tension imposed upon the strand.

In witness whereof, I hereunto subscribe my name this 27th day of September, A. D., 1924.

ARTHUR HERMAN ADAMS.