

March 3, 1959

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TAPE-STRETCHING CONTROL DEVICE FOR ELECTRIC
CABLE WRAPPING MACHINES

2,875,570

Filed Aug. 30, 1955

3 Sheets-Sheet 1

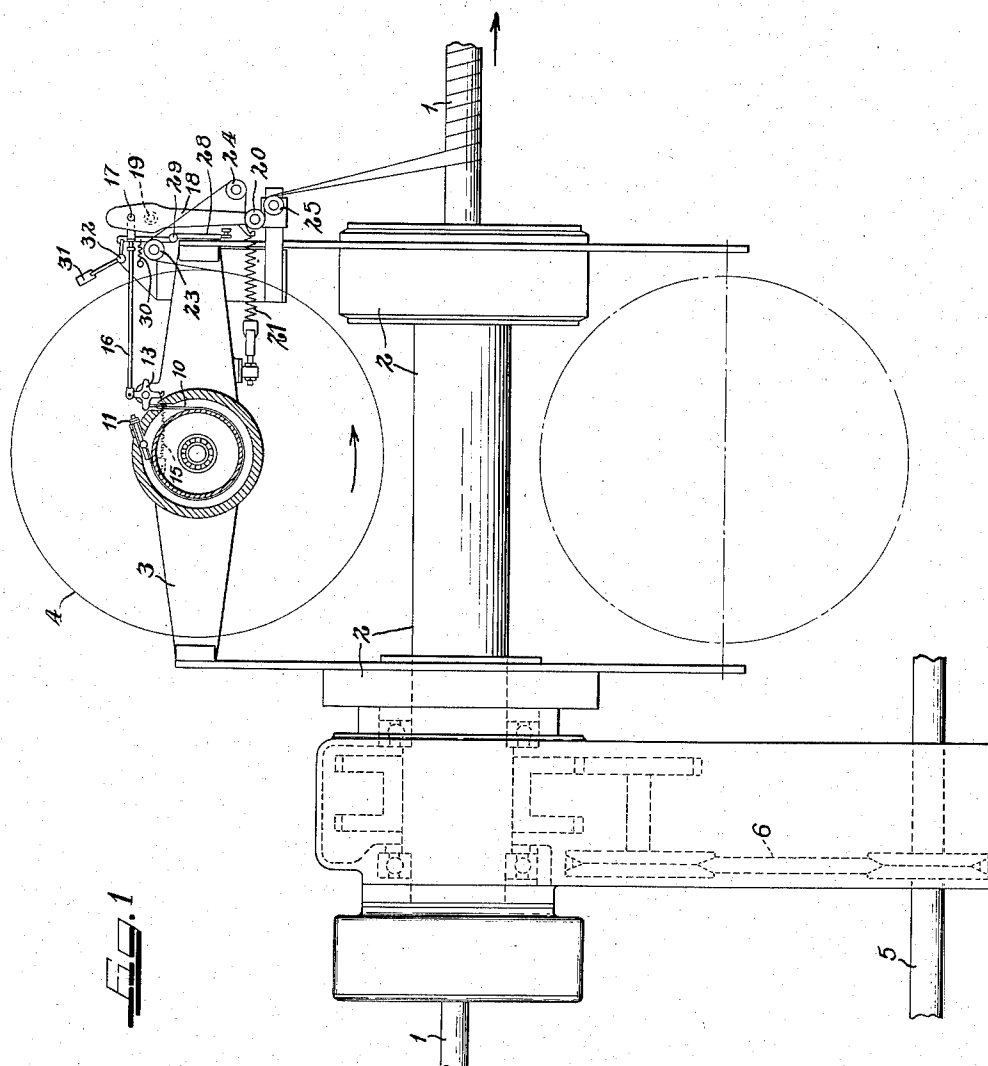


Fig. 1

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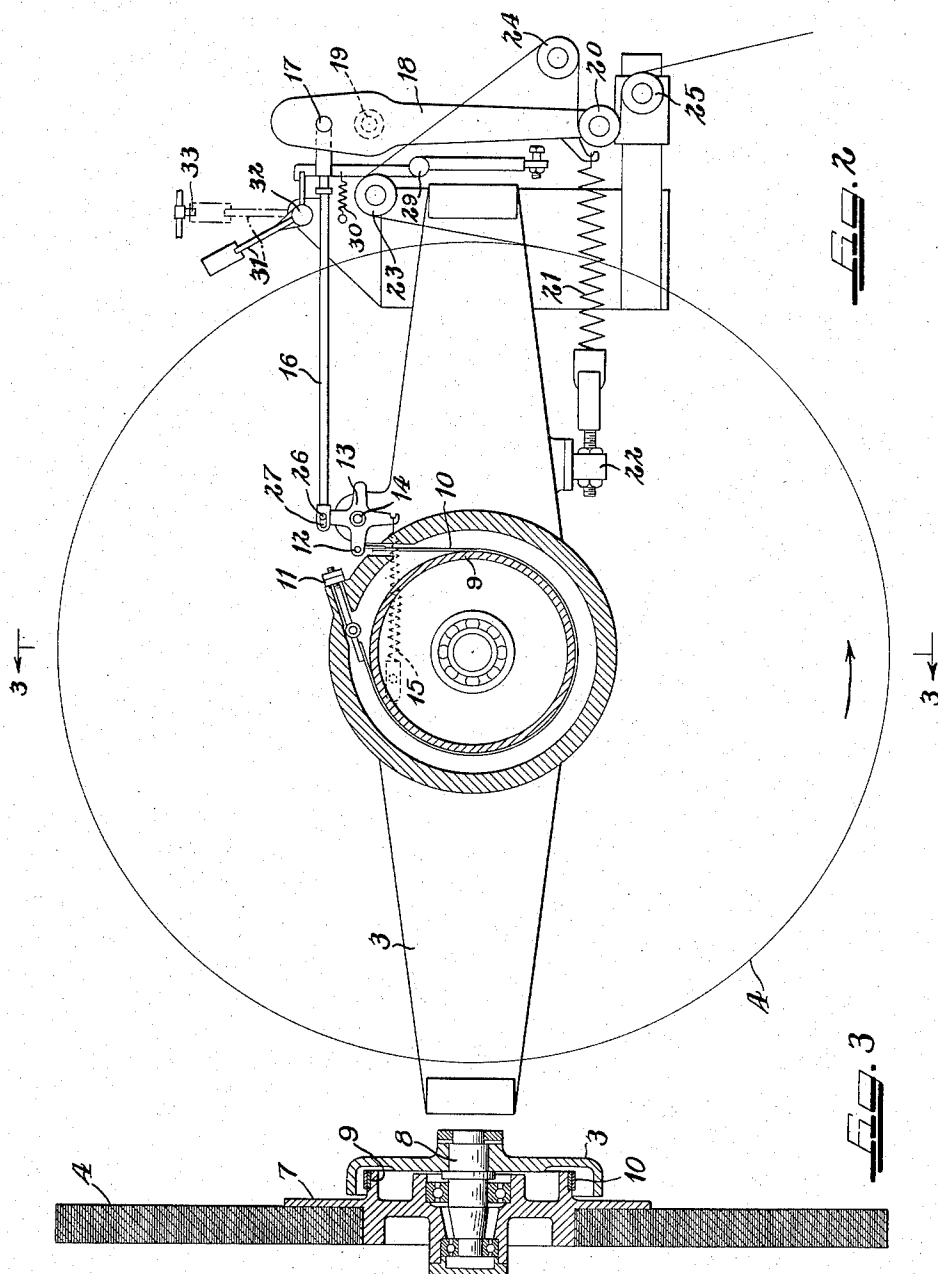
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TAPE-STRETCHING CONTROL DEVICE FOR ELECTRIC CABLE WRAPPING MACHINES

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7 Claims. (Cl. 57—13)

This invention relates to a machine for applying tape to electric cables or the like, and particularly to means for controlling the tension of the tape that is being applied.

In the present state of the art of manufacturing electric cables, the conventional practice employed is that of wrapping tapes of paper or other flexible materials onto the cable by means of suitable machines wherein a roll of paper or other flexible material is caused to rotate at a constant speed about the axis of a cable that is itself being translated at a constant speed in a longitudinal direction. In this way the tape, drawn by the cable, is payed out from the roll and is helically wound on the cable itself.

A machine of the above-mentioned type is normally provided with a considerable number of rolls which, subdivided into groups of, for instance, eight or ten, are assembled on a conventional rotating support on which they are suitably spaced and oriented.

In wrapping electric cables it is usually required that the mechanical tension on the tape which is being wound on the cable shall be maintained fairly constant and of a predetermined value chosen within a suitable range of values according to the design data of the cable itself. Usually, in wrapping machines, the required tension on the tape between the roll and the cable is obtained by a brake that is coaxial with the rotating spindle on which the roll is locked. The brake may be of any desired construction, for instance, a shoe brake or band brake, the application of which is obtained by means of a spring.

A mechanical brake of the above-mentioned character is not sufficient itself to assure a constant pull of the tape of paper or other flexible material which is payed out from the roll and wound on the cable. In fact, for an equal value of tension on the spring which operates the brake, and assuming a constant coefficient of friction of the brake lining, the braking effect is constant and therefore the tension on the tape is inversely proportional to the roll diameter. Consequently, the tension on the tape increases as the roll is payed out, with the result that if, for instance, the final roll diameter is one-third of the initial roll diameter, the final tension will be three times as great as the initial tension. In addition, the assumption that in the brake the coefficient of friction is constant is not strictly true, and this also is a source of uncontrolled variations of tension of the tape. To avoid or reduce these troubles, machines of this character have been provided with a suitable compensating device which varies the braking effect under control of the tension on the tape, in an attempt to maintain the tension on the tape substantially constant, within permissible limits, independently of the variations of the roll diameter and of the coefficient of friction of the brake lining.

In the operation of cable tape-applying machines one of the difficulties in attempting to maintain the tape tension constant arises from the fact that when the machine stops, if an excess of tape is payed out from the roll, the

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braking device is unable to retract this excess, thus leaving the tape slack. In fact, when the revolving cage which carries the tape rolls is stopped, there is a tendency for the cage to move backward with respect to the initial position reached, because of the elasticity and play between the members of the transmission, which results in slack in the tape. The same effect is obtained by the unavoidable relaxation of the cable when the drawing device which causes its forward movement is stopped. The above drawbacks are very troublesome in machines of this type because such machines have to be stopped frequently both for the replacement of exhausted tape rolls, and to carry out periodic control operations and adjustments of the wrapping in the course of its work.

It is one of the objects of the present invention to provide a tape-stretching control device for electric cable wrapping machines in which the tape is maintained under tension even when the machine is stopped, and wherein the unavoidable excess of tape length between the roll and the cable, which results from such stoppage, as above set forth, is recovered.

It is a further object of this invention to provide means for automatically stopping the machine in the event that the tape breaks or becomes slack. Slack in the tape may result from the fact that the roll is not well fastened to the spindle and tends to slide on it.

A preferred device, herein illustrated, embodying the objects of the present invention and having the above-mentioned purposes consists essentially of:

(1) a mechanical brake for the roll supporting spindle and applied, by means of the corresponding lever, with a calibrated spring so as to insure a braking power greater than that required to obtain the desired tension of the tape;

(2) a controlling lever, pivoted on the support of the roll and subjected to the action of a second calibrated spring and to a force proportional to the tension of the tape which is obtained by winding the same, along a certain arc, on a roller integral with said lever;

(3) a rod connecting the adjusting lever to the brake lever and into the end of which is machined an elongated hole which engages the brake lever so as to allow the rod only a limited freedom of displacement;

(4) means to provide the automatic stop of the machine, consisting of a lever system which, moved by the adjusting lever, in case of breakage or of complete relaxation of the tape, actuates an electric contact.

The working principle of the particular embodiment of the present invention herein illustrated is as follows:

(1) The resultant of the equilibrium of the two forces applied to the adjusting lever may be transmitted through the connecting rod, to the brake lever, so that the adjusting lever may reduce the braking action only when the imparted strain tends to release the brake, contrasting the action of its spring. As the tension of the tape increases there is an increase in the releasing action of the brake, so that an automatic control of the tape tension is thus obtained.

(2) When the resultant is in the opposite direction, the adjusting lever may disengage from the brake and is free to rotate through a certain angle under the action of the applied spring, so that it keeps the tape stretched by means of the roller onto which the tape is partially wound, even when the drawing action on the tape is absent, as because of a stoppage of the machine. This makes feasible the recovery of any possible excess of tape length that may have resulted in the zone between the roll and the cable to be wrapped.

(3) In the case of a break or complete relaxation of the tape, the same lever may actuate, by means of said

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suitable lever system, an electric contact which stops the machine.

It is a still further object of the present invention to provide a system wherein the centrifugal forces produced by the rotation of the machine shall not change the equilibrium conditions of the braking system and of the corresponding compensating device.

It is a still further object of the present invention to provide a machine of the above-mentioned character wherein different springs of different typical tension values may be substituted one for another very quickly and easily.

The attainment of the above and further objects of the present invention will be apparent from the following specification taken in conjunction with the accompanying drawings forming a part thereof.

In the drawings:

Fig. 1 is a side view of a portion of a wrapping machine embodying the present invention;

Fig. 2 is an enlarged view of a part of Fig. 1;

Fig. 3 is a sectional view taken along the line 3—3 of Fig. 2; and

Fig. 4 is an enlarged view of a portion of Fig. 3, showing in full lines the normally operating position of the parts and in dot-dash lines the position assumed upon stoppage of the machine.

Reference may now be had more particularly to the drawings wherein like reference numerals designate like parts throughout.

In Fig. 1 of the drawings, an electric cable being wrapped with insulation is indicated at 1. The cable extends through the wrapping machine, as may be seen in Fig. 1, and is being drawn forwardly along its longitudinal axis at a constant speed by means of a suitable drawing device. The cable is drawn through a cage or rotor 2 which is rotated about the longitudinal axis of the cable. The cage includes a number of supports 3 which are spaced about the periphery of the cage, around the cable, each of which supports 3 supports a roll 4 of insulating flexible tape that is to be applied to the cable 1.

In the conventional practice, a wrapping machine for electrical cables consists of a set of machines, such as illustrated in Fig. 1, located one after the other along the longitudinal axis of the cable 1 and all driven in synchronism by a power transmission shaft 5. Power from the shaft 5 is transmitted to the wrapping machine shown in Fig. 1 by means of a variable transmission, shown schematically at 6, wherein this transmission includes a set of adjustable diameter pulleys, one on the power transmission shaft 5 and one on the drive of the wrapping machine, so that the drive ratio between the shaft 5 and the wrapping machine may be gradually varied. One type of gradual speed variator is known under the trade name "P. I. V.," which is usually provided with a kinematic chain or linkage for imparting the motion to each wrapping machine.

For a better understanding of the consideration of the braking system as well as of the corresponding tension adjusting device, there has been illustrated only the support of one roll of the machine together with the braking and adjusting members connected to it, it being understood that each roll support 3 is provided with its own braking and tension adjusting means as illustrated.

The roll 4 is locked to a roll-supporting spindle 7 which rotates about a pivot axis 8 fixed on the support 3, which in turn is mounted on the rotating cage 2 as previously set forth.

The braking of the roll supporting spindle is obtained by a brake, which in the construction herein illustrated, is a band brake having a brake lining 9. This brake lining may be of any preferred brake lining composition, such as, for instance, the type known under the trademark "Ferodo." Obviously, a "shoe" brake may be used.

A brake band 10 acts on the brake lining 9. One end of the brake band is fixed at 11 to the support 3 by

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means of an adjusting screw, while the other end 12 is pivoted to a star-shaped brake lever 13 which in turn is pivoted at 14 to the support 3. The brake lever 13 in this instance includes four arms 90 degrees apart, to one arm of which the brake band is secured. A second arm of the brake lever 13 is engaged by one end of a spring 15 the opposite end of which is connected to a fixed point on the support 3. A third arm of the brake lever 13 carries a pivot 26 which enters into an elongated hole or slot 27 at one end of a rod 16 so as to provide a lost motion pivotal connection between the brake lever 13 and the rod 16 which permits a limited longitudinal movement of the rod 16 at its pivotal connection with the brake lever 13, for a reason which will be brought out as this description proceeds. At its opposite end the rod 16 is pivoted at 17 to an adjusting lever 18 which in turn is pivoted at 19 to the support 3. At the opposite end of the adjusting lever 18 there is mounted a roller 20 which is rotatable about a pivot fixed to the adjusting lever 18. The adjusting lever 18 also has a hook for receiving the end of a tension spring 21. The opposite end of the spring 21 is secured to the support 3 by means of an adjustable fastening member 22 that permits adjustment of the tension of the spring within limits.

The roll 4 rotates in a direction counterclockwise as seen in Figs. 1 and 2, as indicated by the arrow. The tape paying out from the roll 4 passes around a roller 23 which is rotatable about a pivot fixed on the support 3, and then passes over a roller 24 which is also rotatable about a pivot fixed on the support 3, and then is wound around the roller 20 that is carried by the adjusting lever 18, and then passes over a roller 25 that rotates about a pivot fixed to the support 3, from which roller 25 the tape is then taken onto the cable.

When the machine is stopped due to any of a number of unavoidable reasons, there may be a small excessive pay out of the tape, with the result that there is a little excess in the tape length existing between the roll 4 and the cable. Under these conditions, while the roll is strongly held by the braking action of the spring 15, the rod 16 which was pressing on the pivot 26 of the lever 13 is now free to move away from the pivot 26 to the extent permitted by the slot 27. This is due to the fact that the tension of the spring 21 on the adjusting lever 18 is continued while the counter tension on the adjusting lever 18 by the action of the tape on the roller 20 carried by the adjusting lever 18 has been diminished. This freedom of the adjusting lever 18, which thus becomes in a measure disengaged from the brake, continues to the extent permitted by the slot 27. This displacement may be limited even before the rod 16 reaches its limiting right hand position as, for instance, by providing a suitable stop to limit the permissible turning of the adjusting lever 18 about its pivot 19. The small displacement allowable for the rod 16 is multiplied into a much greater permissible displacement of the roller 20, being in the ratios of the radius from the center 19 to the center of the roller 20 on the one hand, and to the center 17 on the other. The excess in tape length is therefore recovered through the displacement of the adjusting lever 18 and of the roller 20.

The tape is therefore stretched under a tension which, started from an initial value more or less equal to that existing in the paying out operation of the tape when the machine is in motion, diminishes the more the greater the recovery to be carried out, until it becomes nil when the displacement of the roller is such as to absorb the initial pull of the spring 21, which is within the limits determined by the slot 27.

In view of the fact that the excess tape length which results at the stopping of the machine is always of a slight amount and as the initial deflection of the spring 21 chosen is sufficiently great, it may be seen that, in practice, satisfactory results are obtainable, in all cases,

maintaining the tape stretched under tension substantially equal to the predetermined working tension.

The relative freedom of the movement of the lever 18, as above set forth, may also be utilized, in accordance with the principles of the present invention, to stop the machine in the event of breakage of the tape or complete loss of tension in the tape, as might result, for instance, if the roll 4 is not well locked onto the spindle 7 and tends to slide on the spindle. In such event, the loss of tension in the tape permits the spring 21 to rotate the adjusting lever 18 to the end of its allowed path as determined by the length of the slot 27 (or as determined by any stop that may be provided). At the end of its allowed freedom of movement, the adjusting lever 18 may actuate an electric switch for stopping the machine. This is illustrated in Fig. 4.

When the adjusting lever 18 moves to its extreme position illustrated in dot-dash lines in Fig. 4, it actuates a lever 28 which is pivoted at 29 to the support 3, rotating the lever 28 against the action of a spring 30, whereby said lever 28 moves from its full line position to its dot-dash position. An angle lever 31 is pivoted at 32 to the support 3. When the lever 28 is in its full line position one arm of the angle lever 31 is engaged by the lever 28 and thereby held against rotation about its pivot 32. When the lever 28 is rotated clockwise by the adjusting lever 18, the lever 28 unlocks the angle lever 31 so that the lever 31 is free to turn about the pivot 32. The lever 31 is suitably counterweighted so that, under the action of centrifugal force, it tends to assume the dot-dash position of Fig. 4. In this new position, during rotation of the cage 2 which carries the supports 3, the end of the lever pushes on a lever 33 that is pivoted to a fixed part of the machine, thereby closing an electric contact and stopping the machine. This mode of electric switch operation eliminates the need of rotating electric contacts with their respective collectors and brushes.

For the best operation of a tape winding machine it is desirable that the centrifugal force produced by the rotation of the machine shall not change the equilibrium condition of the braking system and the corresponding tension compensating or regulating device. In order to achieve this result, the adjusting lever 18 is so constructed that its axis of symmetry passes through its fulcrum 19, and the adjusting lever 18 extends radially with respect to the axis of rotation of the machine, which is the axis of the cable 1 as seen in Fig. 1. Moreover, the adjusting lever 18 is counterweighted so that its center of gravity coincides with its pivot axis 19. The star-shaped lever 13 is also suitably counterweighted for the same purpose.

To minimize the transmission to the braking and adjusting system of the components of the centrifugal forces acting on the springs 15 and 21, the constructive solution of disposing the springs with their axis parallel to the rotational axis of the machine is preferred.

The tension of the tape is mainly determined by the tension of the spring 21 and secondarily by that of the spring 15.

In order to obtain the range of tensions required, only two springs 15 and 21, different in size, could be used if an adjusting system for them is provided. However, since the required tape tensions may range from a few hundred grams to some kilograms, the use of a single spring 21 to meet all of these requirements would be difficult. Such a spring if satisfactory for the lower values of tension would allow only a reduced recovering capacity of the possible excess in the tape length from the roll to the cable.

In the preferred embodiment of the present invention, it is intended to use for the spring 21 a different spring for each typical value in the range of the tensions required (for instance, a different spring for each of the following tensions: .5, .8, 1, 1.2, 1.5, 2, 2.5, 3 kg.). The desired spring calculated for each of these typical ten-

sions and calibrated so as to give the required tension with the predetermined deflections may be readily assembled in the machine. The ends of the springs 15 and 21 may be eye-shaped so as to facilitate the replacement of these springs. The adjusting screw device 22 for the left hand end of the spring 21 permits adjustment of the tension of the spring 21 so as to allow small adjustments of the tape tension with respect to the average value insured by the particular spring 21 being used.

The spring 15 also contributes, although in a reduced way, to the value of the tape tension. In the preferred embodiment of the present invention, a number of springs 15 of different sizes may be provided to cover successive ranges of values of tape tension (for instance, a spring for tensions from .5 to .8 kg., one for tensions from 1 to 1.5 kg., and one for those ranging from 2 to 3 kg.). No tension adjusting device for the spring 15 is necessary.

In the preferred embodiment of the present invention, herein illustrated, the tape-stretching control device for controlling the tension on a tape that is being wrapped, has been shown as applied to a structure wherein the object being wrapped is a cable. It is within the purview of the present invention to apply the principles of the present invention to devices other than cables, wherein a continuous length of the object being wrapped is moved progressively as a ribbon of tape is wrapped therearound. For instance, instead of a cable 1, the object being wrapped by the tape may be any long tube, pipe or rod, either already fabricated or in the process of fabrication.

In compliance with the requirements of the patent statutes there has here been shown and described a preferred embodiment of the present invention. It is, however, to be understood that the invention is not limited to the precise construction here shown, but may be widely changed or modified within the scope of the present invention.

What are considered new and desired to be secured by Letters Patent are:

1. A machine for winding tape under tension around a cable, said machine including a rotor having means for supporting rolls of tape and for each roll said rotor having the following: a brake controlling the tension of the tape being wound, and tape tension-responsive apparatus including a member movable in one direction by the tension on the tape and including spring means extending parallel to the axis of rotation of the rotor for moving the member in the opposite direction, means confining the movement of the member to a path that is fixed with respect to the axis of the rotor, means controlled by movement of the member in one range of its movement to regulate the tape tension by diminishing the braking effect on the tape in an amount which is a function of the tape tension, means responsive to the movement of the member in a different range of its movement to take up slack in the tape while maintaining the tape under tension, and means for adjusting the spring tension of the spring means to vary the tape tensions in each of the two different ranges of movement of the member.

2. Apparatus for winding tape around a cable or the like, said apparatus including a rotor, a tape reel-supporting structure rotatably mounted on the rotor, means for rotating said rotor around the object about which the tape is to be wound, friction brake means for controlling the pay out of tape from a reel on said structure and thereby controlling the tension of tape as the tape is being payed out, brake regulating means controlled by the tape tension as the tape is being payed out for regulating the brake to keep the tension in the tape constant within predetermined limits, said regulating means including a member pivoted for movement about an axis that is fixed with respect to the axis of rotation of the reel, said member being movable in one direction by the

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tension in the tape, and spring means for moving the member in the opposite direction, said spring means being disposed with its longitudinal axis parallel to the axis of rotation of the rotor, and a lost motion connection between said member and the brake to cause the spring means to move the member in a direction for taking up tape slack after the brake has been moved to its maximum braking position, and maintaining the tape taut.

3. A wrapping machine for electric cables comprising at least one rotor through which the cable being wound moves longitudinally along the axis of rotation, each rotor including a plurality of supports each having means for rotatably supporting a roll of insulating tape and means for controlling the tension and the slack in its tape, the supports being in spaced relation to one another around the axis of rotation of the rotor; said tension and slack control means on each support comprising a friction brake controlling the turning of the roll of tape in its pay out direction, a brake control lever, a spring biasing the brake control lever to actuate the brake to an over-pulled position, a second lever for controlling the tension and taking up the slack in the tape, means pivoting the second lever to the support about an axis spaced from and fixed with respect to the axis of rotation of the rotor, spring means urging the second lever to turn about its pivot in one direction, the second lever being urged in the opposite direction by the tension force on the tape and being maintained in a position of equilibrium by the two forces, connecting means connecting the two levers so that the second lever controls the brake control lever, said connecting means including a pin and an elongated slot type connection to permit the second lever a limited freedom of displacement from the first lever so that in the event of sudden stopping of the machine the second lever may move to recover resulting tape slack.

4. A structure such as is defined in claim 3 wherein the second lever has an axis of symmetry passing through its pivot and normally disposed radially with respect to the axis of rotation of the machine to reduce the effects of centrifugal forces on said second lever.

5. A structure such as defined in claim 3 wherein said springs are disposed with their axes parallel to the axis of rotation of said rotor.

6. A wrapping machine for electric cables comprising at least one rotor through which the cable being wound moves longitudinally along the axis of rotation, each rotor including at least one support and each support having means for rotatably supporting a roll of insulating tape and means for controlling the tension and the slack in its tape; said tension and slack control means comprising a friction brake controlling the turning of the roll of tape in its pay out direction, a brake control lever, a spring biasing the brake control lever to actuate the brake

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to an over-pulled position, a second lever for controlling the tension and taking up the slack in the tape, means pivoting the second lever to the support about an axis spaced from and fixed with respect to the axis of rotation of the rotor, spring means urging the second lever to turn about its pivot in one direction the second lever being urged in the opposite direction by the tension force on the tape and being maintained in a position of equilibrium by the two forces, connecting means connecting the two levers so that the second lever controls the brake control lever, said connecting means including a pin and elongated slot type connection to permit the second lever a limited freedom of displacement from the first lever so that in the event of sudden stopping of the machine the second lever may move to recover resulting tape slack.

7. A wrapping machine for electric cables comprising at least one rotor through which the cable being wound moves longitudinally along the axis of rotation, each rotor including at least one support and each support having means for rotatably supporting a roll of insulating tape and means for controlling the tension and the slack in its tape; said tension and slack control means comprising a friction brake controlling the turning of the roll of tape in its pay out direction, a brake control lever, a spring biasing the brake control lever to actuate the brake to an over-pulled position, a second lever for controlling the tension and taking up the slack in the tape, means pivoting the second lever to the support about an axis spaced from and fixed with respect to the axis of rotation of the rotor, spring means urging the second lever to turn about its pivot in one direction the second lever being urged in the opposite direction by the tension force on the tape and being maintained in a position of equilibrium by the two forces, connecting means connecting the two levers so that the second lever controls the brake control lever, said connecting means including a pin and elongated slot type connection to permit the second lever a limited freedom of displacement from the first lever so that in the event of sudden stopping of the machine the second lever may move to recover resulting tape slack, said second lever having an axis of symmetry passing through its pivot and normally disposed radially with respect to the axis of rotation of the machine.

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