DEVICE FOR TENSIONING TAPE AND REDUCING SLACK

Clifford W. Henderson, Princeton Township, Mercer County, and Frederick J. Jannett, West Millington, N.J., assignors to Western Electric Company, Incorporated, New York, N.Y., a corporation of New York
Filed Aug. 12, 1964, Ser. No. 388,992
6 Claims. (Cl. 242—75.5)

This invention relates to an apparatus for feeding material of an indefinite length from a reel to a work station and more particularly to an apparatus for feeding material of an indefinite length from a reel to a work station under constant tension.

In the manufacture of wound capacitors, it is frequently necessary to wind two foil tapes with a dielectric tape therebetween on a mandrel to form a capacitor body. When a capacitor body has been formed, the tapes are cut in preparation for the winding of the next capacitor body. In order properly to wind the tapes on the mandrel, it is essential that the tapes be pulled from their respective supply reels under constant tension. Further, due to recoil of the reels, slack in the tapes results from the reels continuing to rotate subsequent to the winding operation. When slack is present in the tape or when the tape is not properly tensioned, difficulty occurs in matching the tapes during the winding operation and in cutting the tape subsequent to the winding operation. Further, where movement of the winding facilities is desirable, for example, to seal the capacitor, it is essential that any resulting slack in the tape be taken up.

It is, therefore, an object of this invention to provide facilities for delivering material of an indefinite length to a work station under constant tension. A further object of this invention is to provide facilities for delivering material of an indefinite length to a work station under constant tension without slack developing in the material during successive operations.

With these and other objects in view, the instant invention contemplates the utilization of facilities for permitting a material supply reel to rotate in a forward direction when material of indefinite length is pulled therefrom while urging the reel to rotate in the reverse direction to tension material pulled from the reel. Additional facilities are also utilized to permit the reel limited rotation in the reverse direction to take up slack in the material when tension on the material is released.

It is to be understood that any material capable of being wound on a reel may be drawn from the reel under tension and slack in the material removed by following the teachings of the instant invention. Materials such as strips, ribbons, tape, wire and cordage are examples of the types of materials to which the invention may be applied. The following disclosure uses the term "tape" as an example of one particular material to which the invention has application.

A more complete understanding of the invention may be obtained by reference to the following description when taken in conjunction with the drawings, wherein:

FIG. 1 is a side elevational view of an apparatus embodying the principles of the instant invention showing portions of the apparatus in section and portions broken away for purposes of clarity;

FIG. 2 is a sectional view taken from FIG. 1 along lines 2—2 showing the winding reel, in addition, details of a typical work station; and

FIG. 3 is a sectional view of FIG. 1 taken along lines 3—3 showing details of facilities for permitting limited rotation of the winding reel.

As illustrated in FIG. 1, a supply reel 10 is keyed to shaft 11 for rotation therewith. A cup 12 of a drag-cup motor generally indicated by the numeral 13 is also keyed to shaft 11 for rotation therewith. The motor 13 is of commercial design and operates with a stationary field winding 14. Shaft 11 is mounted for rotation on pillow blocks 16. The drag-cup motor 13 is actuated by energizing the stationary field winding 14 so as to rotate the cup 12 in the direction of arrow 15 (clockwise in FIG. 2). Current may be supplied to the field winding 14 by a commercially available source of A.C. electrical power. Housing or stand 17 supports the field winding 14 on the shaft 11 and is provided with ball bearings 18 to permit shaft 11 to rotate with respect to the winding 14. Tape 21 (FIG. 2) is pulled from reel 10 by a forked mandrel 22. The mandrel 22 could be a round mandrel, a bobbin or any other suitable rotating device. As an electric motor 23 rotates the mandrel 22 in the direction of arrow 24, the tape 21 is pulled from reel 10 and rotates the reel 10 in the direction of arrow 25 (counterclockwise in FIG. 2). Thus, motor 13 opposes the rotation of reel 10 in the direction of arrow 26, and maintains a constant tension on the tape 21 as it is pulled from the reel. Tension on the tape 21 may advantageously be controlled and adjusted by varying the current flow to the field winding 14.

The tape 21 is directed to the mandrel 22 by guides 27. The mandrel 22, motor 23, and guides 27 are merely illustrative of a facility which may be used for pulling tape from the reel 10. Additional guides may be used if necessary or the guides may be eliminated. In capacitor winding, for example, a plurality of tapes may be pulled from separate reels through the guides 27 and wound on the mandrel 22 to form a wound capacitor body. After a certain predetermined number of revolutions of the mandrel 22, the mandrel would be stopped and the tapes cut. Facilities (not shown) would also be provided for threading the cut ends of the tapes onto the mandrel 22 for subsequent winding operations.

In some capacitor winding operations it would be desirable to displace the mandrel 22 to the left (FIG. 2) into contact with a heater element (not shown) to seal the tapes to the wound capacitor body prior to winding the tape. It would then be necessary to return the mandrel 22 to the position shown in FIG. 2 preparatory to the next winding operation, introducing some slack in the tape. For simplicity, these details have not been illustrated here and are only mentioned to show the general utility of the invention. The principles of the invention may be understood from the instant disclosure by assuming that the mandrel rotates for a predetermined interval, rests, and then rotates again, in repeating cycles.

In order to prevent the cup of motor 13 from running away with the reel 10 when the tape 21 is cut or breaks, or otherwise when tape tension is suddenly relieved, a bidirectional clutch, generally indicated by the numeral 31, is utilized. The clutch 31 has two clutch elements 32 and 33, one of which, clutch element 32, is keyed to the shaft 11. Clutch element 33 is mounted for free rotation on the shaft 11 by bearings 34. Spring 36 extends across both clutch elements with the convolutions of the spring in close juxtaposition. The spring 36 is in close contact with clutching surfaces 37 of the clutch elements 32 and 33 and is wound in such a way that rotation of the clutch element 32 in a counterclockwise direction (FIG. 3) tends to uncoil the spring. On the other hand, rotation of the clutch element 32 in a clockwise direction (FIG. 3) tends to coil the spring 36. The clutch 31 permits rotation of the shaft 11 relative to clutch element 33 only in the direction of rotation of arrow 26. When the shaft 11 starts to rotate clockwise relative to the clutch element 33, the spring is coiled into a tight friction fit with the clutching surfaces 37 to resist any rotation of
3 the clutch element 32 and shaft 11 relative to the clutch element 33. Thus, when the tape 21 is cut or breaks, the clutch 31 prohibits any rotation of the shaft 11 relative to clutch element 33 in a clockwise direction (FIG. 2). This prevents the cup 12 from running away with the reel 10 when the tension on the tape 21 is relieved by cutting the tape or when the tape breaks.

The particular clutch described above is a commercial clutch of the type generally used in telephone dials. Other unidirectional clutches can be substituted for the disclosed clutch and the instant clutch is only disclosed as an example of a particular type of clutch which may be used.

Due to inertia of the reel, the reel will continue to rotate through some arc in the direction of arrow 26 subsequent to the mandrel 22 stopping. This will introduce slack in the tape 21. Slack in the tape may also result where it is necessary to displace the mandrel 22 subsequent to the winding operation but prior to cutting the tape, as discussed briefly above.

Slack in the tape is undesirable as during subsequent operations it will be difficult to match the tape 21 with other tape or tapes being fed to the mandrel 22. To avoid the presence of slack in the tape 21, a stationary U-shaped member 41 (FIGS. 1 and 3) is provided for permitting limited rotation of clutch element 33. The stationary member 41 is provided with a pair of adjustable stops 42 and 43 for defining the amount of rotation permitted clutch element 33. Finger or screw 44 is fixed to clutch element 33 and engages either stop 42 or 43 when the shaft 11 is rotated. When the reel 10 is rotated counterclockwise (FIG. 2), with the tape 21 being pulled therefrom, the clutch element 32 is rotated in a counterclockwise direction with shaft 11 to uncoil the spring 36. The clutch element 33 will also rotate with the shaft 11 due to friction in a counterclockwise direction (FIG. 3) until screw 44 strikes stop 42. Spring 36 will then slip on the clutching surfaces 37 permitting clutch element 32 and shaft 11 to rotate in a counterclockwise direction relative to clutch element 33 so as to permit rotation of reel 10 in the direction of arrow 26 (FIG. 2). Upon the mandrel 22 stopping or the tension on tape 21 being released in any manner, motor 13 rotates shaft 11 and clutch 31 in a clockwise direction until finger 44 of clutch element 33 reaches stop 43.

Further rotation of clutch element 33 is prohibited when finger 44 reaches stop 43. As motor 13 continues to urge clutch element 32 to rotate in a clockwise direction with the reel 10 in a clockwise direction. No perceptible rotation of the clutch element 32 in a clockwise direction relative to clutch element 33 is experienced before the spring 36 locks the clutch element 32 against rotation in the clockwise direction. By adjusting the position of stops 42 and 43, the distance through which the shaft 11 is permitted to rotate in a clockwise direction is controlled to remove slack in the tape 21. Thus, expected slack in the tape 21 may be compensated for by presetting the distance between stops 42 and 43. It should be noted that clutch 31 prohibits rotation of reel 10, shaft 11, and clutch element 32 relative to clutch element 33 in a clockwise direction. However, reel 10, shaft 11, clutch element 32 and clutch element 33 do rotate together in a clockwise direction until screw 44 strikes stop 43.

In this manner, a constant tension is maintained on the tape 21 as it is pulled from the reel and slack in the tape is eliminated when the winding operation stops.

It is to be understood that many modifications and arrangement of elemental parts may be made without departing from the spirit of the invention. Directions of rotation of various parts are given only by way of illustration and may be changed for different applications of the invention.

What is claimed is:

1. A device for dispensing material of indefinite length under tension and for taking up slack in the material upon release of such tension, comprising:
   a shaft,
   a material supply reel mounted for rotation with the shaft in a forward direction when material is pulled therefrom,
   means for urging the shaft to rotate in the reverse direction to tension the material pulled from the reel,
   a clutch for permitting the shaft to rotate with the reel in the forward direction while prohibiting the shaft from rotating in a reverse direction relative to the clutch, and
   means for permitting a predetermined amount of rotation of the clutch in the reverse direction when tension on the material is released to permit the shaft and the reel to rotate a predetermined amount in the reverse direction to take up slack in the material,

2. A device for dispensing material of indefinite length under tension and for taking up slack in the material upon release of such tension, comprising:
   a shaft,
   a material supply reel mounted on the shaft for rotation therewith in a forward direction when material stored on the reel is pulled therefrom,
   means for urging the reel to rotate in the reverse direction to tension material pulled from the reel,
   a first clutch element fixedly mounted to the shaft for rotation therewith,
   a second clutch element carried by the shaft for free rotation relative to the shaft,
   means for permitting free rotation of the reel, shaft, and first clutch element in the forward direction relative to the second clutch element while prohibiting rotation of the reel, shaft, and first clutch element relative to the second clutch element in the reverse direction; and
   means for permitting limited rotation of the second clutch element in the reverse direction when tension on the material is released to permit limited rotation of the reel in the reverse direction to take up slack in the material,

3. A device for dispensing material of indefinite length under tension and for taking up slack in the material upon release of such tension, comprising:
   a shaft,
   a reel fixedly mounted to the shaft for rotation with the shaft in a forward direction when material is pulled from the reel,
   means for urging the shaft to rotate in the reverse direction to maintain tension on material pulled from the reel,
   a first clutch element fixedly mounted to the shaft for rotation therewith,
   a second clutch element carried by the shaft for free rotation relative to the shaft,
   a spring connecting the first clutch element and second clutch element for permitting rotation of the first clutch element relative to the second clutch element in the forward direction while prohibiting rotation of the first clutch element relative to the second clutch element in the reverse direction, and
   means permitting limited rotation of the second clutch element in the reverse direction when tension on the material is released to take up slack in the material,

4. A device for dispensing material of indefinite length under constant tension and for taking up slack in the material upon release of such tension, comprising:
   a shaft,
   a reel fixedly mounted to the shaft for rotation with the shaft in a forward direction when material is pulled from the reel,
   means for urging the shaft to rotate in the reverse direction to maintain tension on material pulled from the reel,
3,262,651

a first clutch element fixedly mounted to the shaft for rotation therewith;
a second clutch element carried by the shaft for free rotation relative to the shaft;
a spring connecting the first clutch element and second clutch element for permitting rotation of the first clutch element relative to the second clutch element in the forward direction while prohibiting rotation of the first clutch element relative to the second clutch element in the reverse direction; and
means permitting limited rotation of the second clutch element in the reverse direction when tension on the material is released for taking up slack in the material, including adjustable elements for defining the amount of rotation permitted the second clutch element.

5. A device for dispensing material of indefinite length under constant tension and for taking up slack in the material upon release of such tension, comprising:
a shaft;
a reel fixedly mounted to the shaft for rotation with the shaft in a forward direction when material is pulled from the reel;
means for urging the shaft to rotate in a reverse direction to maintain tension on material pulled from the reel;
a first clutch element fixedly mounted to the shaft for rotation therewith;
a second clutch element carried by the shaft for free rotation relative to the shaft;
a spring connecting the first clutch element and second clutch element for permitting rotation of the first clutch element relative to the second clutch element in the forward direction while prohibiting rotation of the first clutch element relative to the second clutch element in the reverse direction;
a finger fixedly mounted to the second clutch element for rotation therewith;
a first stop mounted in the path of rotation of the finger in the forward direction to limit the distance the second clutch element can rotate with the shaft in the forward direction; and
a second stop mounted in the path of rotation of the finger to limit the distance the second clutch element can rotate with the shaft in the reverse direction, rotation of the second clutch element in the reverse direction permitting rotation of the reel in the reverse direction to remove slack from the material.

6. A device for dispensing material of indefinite length under constant tension and for taking up slack in the material upon release of such tension, comprising:
a shaft;
a reel fixedly mounted to the shaft for rotation with the shaft in a forward direction when material is pulled from the reel;
means for urging the shaft to rotate in a reverse direction to maintain tension on material pulled from the reel;
a first clutch element fixedly mounted to the shaft for rotation therewith;
a second clutch element carried by the shaft for free rotation relative to the shaft;
a spring connecting the first clutch element and second clutch element for permitting rotation of the first clutch element relative to the second clutch element in the forward direction while prohibiting rotation of the first clutch element relative to the second clutch element in the reverse direction;
a finger fixedly mounted to the second clutch element for rotation therewith;
a first stop mounted in the path of rotation of the finger in the forward direction to limit the distance the second clutch element can rotate with the shaft in the forward direction; and
a second stop mounted in the path of rotation of the finger to limit the distance the second clutch element can rotate with the shaft in the reverse direction, rotation of the second clutch element in the reverse direction permitting rotation of the reel in the reverse direction to remove slack from the material.

References Cited by the Examiner
UNITED STATES PATENTS
Re. 23,280 10/1950 Applegate.
2,077,925 4/1937 Gent 242—75.5 X
2,469,706 5/1949 Winter—242—75.51
FOREIGN PATENTS
204,563 11/1956 Australia.

MERVIN STEIN, Primary Examiner.
STANLEY N. GILREATH, Examiner.
N. L. MINTZ, Assistant Examiner.