United States Patent

Nakai et al.

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[54] DETECTION ARRANGEMENT OF WINDING SPEED ON A TAKE-UP WINDER

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[52] **U.S. Cl.**.....**242/45**

[51] **Int. Cl.**.....**B65h 59/38**

[58] **Field of Search**.....242/45

[56] **References Cited**

UNITED STATES PATENTS

3,350,022	10/1967	Bense	242/45
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Primary Examiner—Stanley N. Gilreath
Assistant Examiner—Milton Gerstein
Attorney—Milton J. Wayne

[57] **ABSTRACT**

Improvement in or relating to an arrangement for detecting winding speed of running strandular materials on a multiple packages on a common spindle type take-up winder having multiple compensator arms with dancer rolls for the strandular materials independently operable, upon speed deviation of the strandular materials, on a common shaft connected to a unit for controlling the spindle rotational speed and the detection is carried out with possible minimum tension fluctuation within and/or between the strandular materials.

7 Claims, 8 Drawing Figures

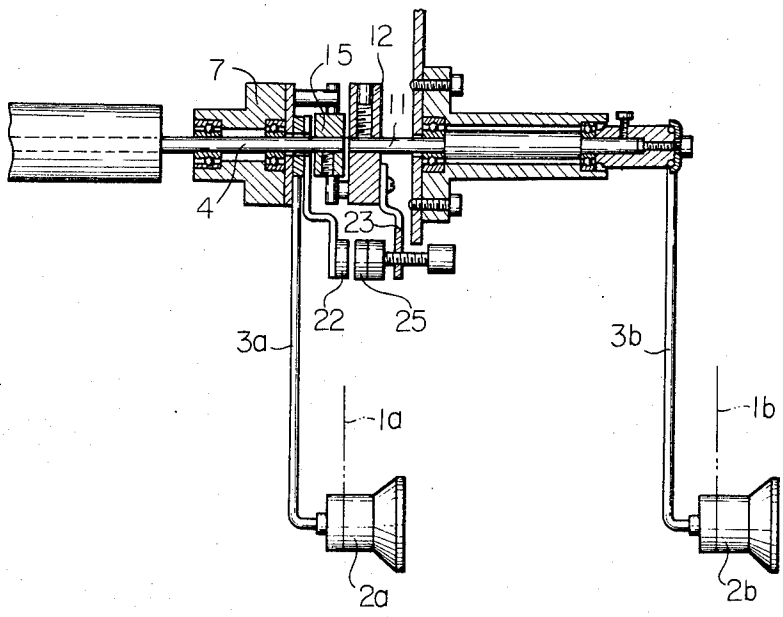


Fig. 1A

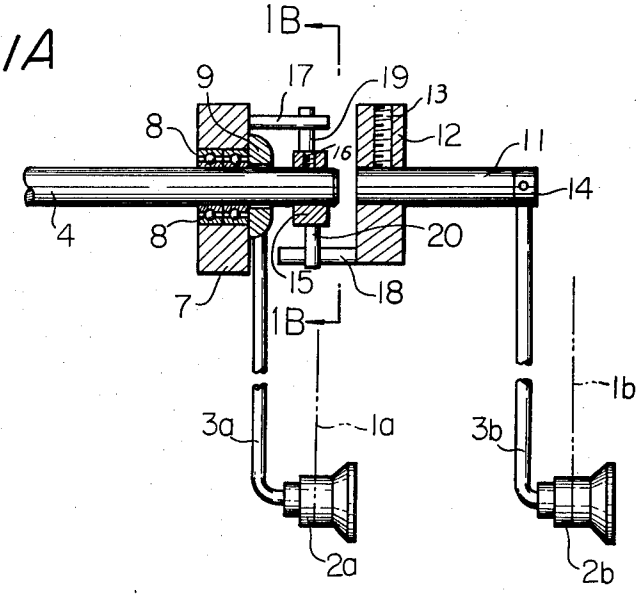


Fig. 1B

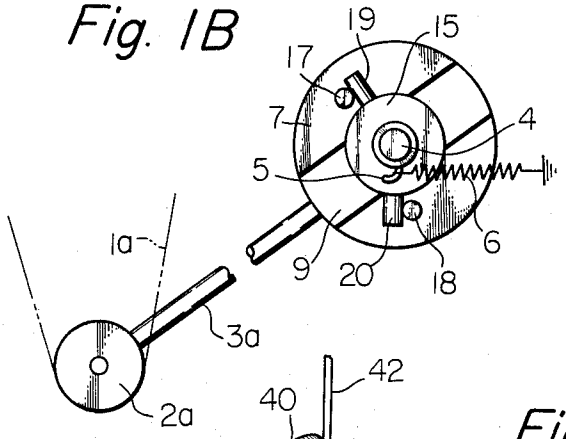
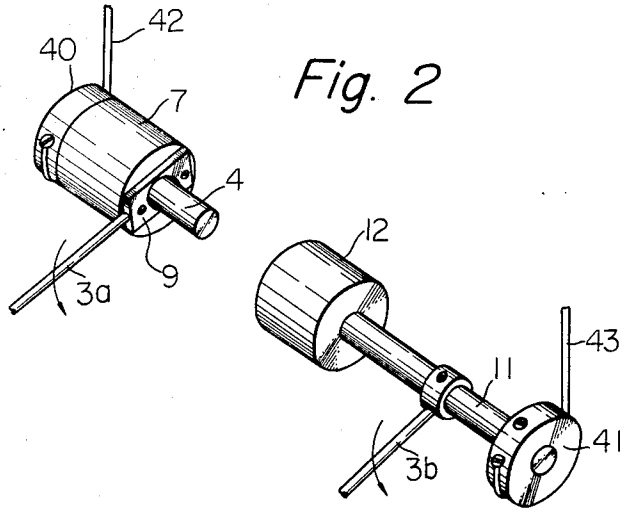


Fig. 2



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Fig. 3

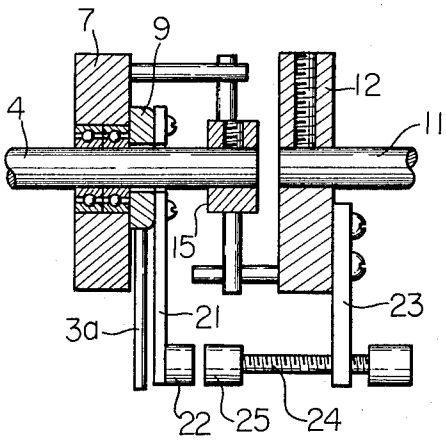
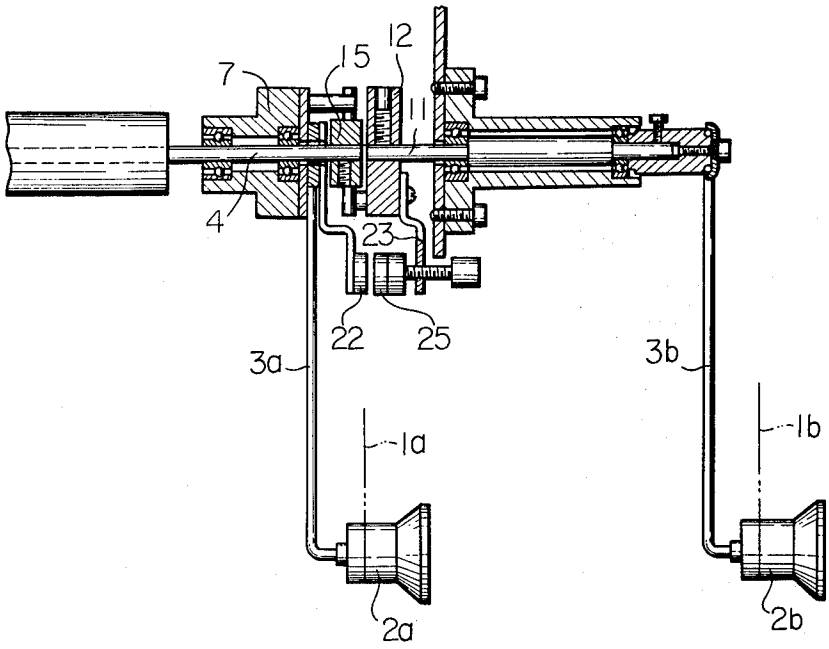


Fig. 4



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Fig. 5

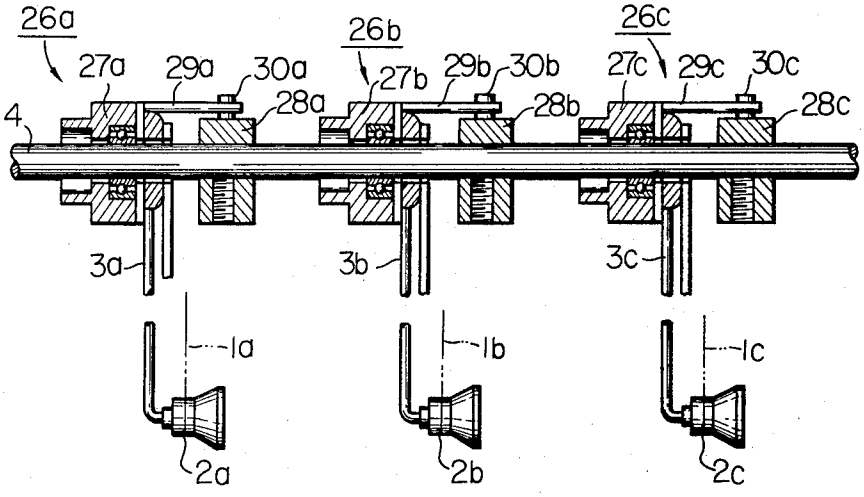


Fig. 6

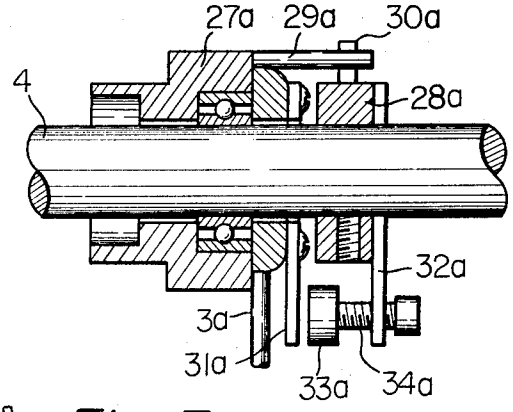
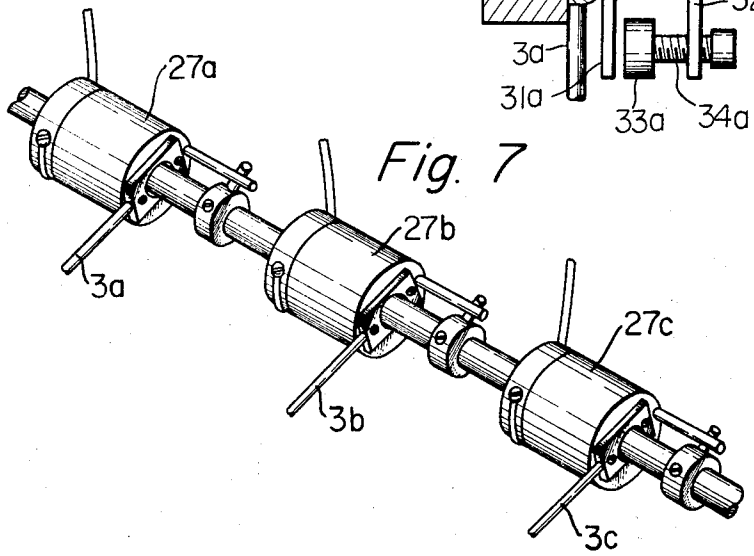


Fig. 7



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DETECTION ARRANGEMENT OF WINDING SPEED ON A TAKE-UP WINDER

The present invention concerns improvement in or relating to a detection arrangement of winding speed on a take-up winder, more particularly concerns an improved winding speed detecting arrangement for strandular materials such as, for example, yarns wound on a take-up winder wherein multiple bobbins or packages are mounted on a common rotational spindle in an axial alignment and the strandular materials are wound on the corresponding packages at given supply speed.

In the conventional arrangement of the take-up winder of the above-described type, the strandular materials are processed at a constant speed from given supply sources to the packages via corresponding rolls supported by compensator arms. The several compensator arms are at their ends mounted on a common shaft connected to a control mechanism. With fluctuating change in the speed of the processed strandular material, the corresponding roll changes its location causing corresponding axial turning of the common shaft via a compensator arm and this turning is sensed by the control mechanism. The control mechanism issues, upon the sensing, corresponding signals to affect the rotational speed of the spindle driving motor and the rotational speed of the spindle is controlled so as to compensate the fluctuating change in the speed of that strandular material. Because the compensator arms are fixedly mounted, at their ends, on a common shaft, the control effect caused by the speed fluctuation of one strandular material is inevitably imposed upon the processing condition of the other strandular materials of normal speed. This means that the imposed control effect on one strandular material disturbs the normal processing condition of the remaining strandular materials.

One typical attempt to mitigate the above-mentioned drawback was disclosed by W. M. Bense in his U. S. Pat. No. 3,350,022 in which arrangement respective compensator arms act independently upon a common shaft connected to a control unit for effecting the rotational speed of the common spindle supporting the multiple packages. As far as the yarn breakage is concerned, this arrangement has no trouble. But, when the fluctuating change in the yarn speed is to be compensated, this arrangement is accompanied with the following fatal drawbacks. As above-mentioned, respective compensator arms act independently upon the common shaft which is rotationally urged into pressure contact with the respective compensator arms by springs, the number of which corresponds to the number of the compensator arms. Assuming that two strands of yarns are processed, the common shaft is urged against the two compensator arms by two sets of springs. Lowering in the winding speed of the first yarn causes movement of the first compensator arm away from contact with the common shaft. Then the urging force exerted on the common shaft by the two sets of springs has to be borne by the second compensator arm only and this naturally causes undesirable increase in the tension of the second yarn for which the second compensator arm is responsible. Thusly, the tensioning condition of the second yarn is brought out of order. This means that the operation for compensating the speed lowering of the first yarn unnecessarily causes an undesirable increase in the tension of the second yarn.

The winding speed detecting arrangement of the present invention proposes to eliminate drawbacks inevitably encountered in the prior art.

Further, the winding speed detecting arrangement of the present invention proposes to ascertain an effective speed compensation using a simplified mechanical arrangement.

In order to attain the objects of the invention, the winding speed detection arrangement of the present invention is provided with a plurality of compensator arms having respective dancer rolls for the corresponding strandular materials. Means for urging the compensators independently from each other is provided so as to impose pertinent tension on the strandular materials. The compensator arms are independently operable upon a common shaft connected to a unit for controlling the take-up speed of the strandular materials. Movement of any of the compensator arms caused by the speed fluctuation of the strandular material passing around the corresponding dancer roll causes axial turning of the common shaft and this turning agitates the control unit so as to change the take-up speed, thereby the speed fluctuation being duly compensated with possible minimum tension fluctuation within and/or between the strandular materials.

Further features and merits of the present invention will become more apparent from the following detailed description taken in conjunction with the appended drawings in which like numbers refer to like elements throughout.

FIG. 1A is a partly sectional front view of a principal embodiment of the winding speed detecting arrangement of the present invention wherein two sets of strandular materials are processed,

FIG. 1B is a partly sectional side view of the arrangement seen in a direction IB—IB in FIG. 1A,

FIG. 2 is a partly omitted diagrammatic perspective view for showing mechanism for tensioning the strandular materials in the arrangement shown in FIGS. 1A and 1B,

FIG. 3 is a partly sectional front view of a main part of a modification of the arrangement shown in FIGS. 1A and 1B,

FIG. 4 is a partly sectional front view of an embodiment of the winding speed detection arrangement of the present invention suited for use in a practical mill production,

FIG. 5 is a partly sectional front view of another embodiment of the arrangement of the present invention,

FIG. 6 is a partly sectional front view of a modification of the arrangement shown in FIG. 4,

FIG. 7 is a partly omitted diagrammatic perspective view for showing mechanism for tensioning the strandular materials in the arrangement shown in FIG. 5.

Referring to FIGS. 1A and 1B, a principal embodiment of the arrangement of the present invention is shown being employed in a winder wherein two packages are mounted for winding purpose on a common spindle. In the shown arrangement, the first strandular material **1***a* passes over a dancer roll **2***a* (first) mounted on a free extremity of a compensator arm **3***a* (first) while the second strandular material **1***b* passes over another dancer roll **2***b* (second) mounted on a free extremity of a compensator arm **3***b* (second). Passing over the dancer rolls **2***a* and **2***b*, both strandular materials **1***a* and **1***b* advance from given supply sources to the respective packages for winding purposes at constant supply speed. Approximately in parallelism with the axial direction of the dancer rolls **2***a* and **2***b*, a common shaft **4** is disposed in an axially turnable arrangement. One end of the common shaft **4** is connected to a unit (not shown) for controlling rotational speed of the common spindle on which the two packages are mounted. In the shown embodiment, common shaft **4** is provided with a hook **5** peripherally fixed thereto and a tension spring **6** is at its one end connected to the hook **5** and at its other end fixed to a stationary stop as shown in FIG. 1B. This spring force slightly urges the common shaft **4** to axially turn in a direction to speed up the rotational speed of the common spindle via the control unit. However, the spring force provided by the spring **6** should not be designed so strongly as to effect the tensioning condition of the processed strandular materials. In the case of the illustration shown in FIG. 1B, the common shaft **4** is urged in a counterclockwise direction by the spring force of the spring **6**. A disc **7** (first) is mounted on the common shaft **4** in an axially rotational and coaxial arrangement via bearings **8** and the compensator arm **3***a* is radially and fixedly supported by the disc **7** via bracket **9** fixed to one side surface of the disc **7**. Therefore, the swing of the compensator arm **3***a* around the axis of the common shaft **4** causes axial turning of the first disc **7** around the common shaft **4**. In an axial alignment with the common shaft **4**, another shaft **11** is disposed in a separate and rotational arrangement. Another disc **12** (second) is axially and fixedly mounted on the other shaft via a set screw **13** in a distantly facing arrangement with the first disc **7** on the common shaft **4**. Another end of the shaft **11** is provided, via a fixed collar **14**, with the radially and fixedly mounted com-

pensator arm 3*b*. Being spacedly sandwiched by the two discs 7 and 12, an intermediate disc 15 is coaxially and fixedly mounted on the common shaft 4 via a set screw 16.

The first disc 7 is provided with a rod 17 projecting from a side surface of the disc 7 towards the second disc 12 whereas the second disc 12 is provided with a rod 18 projecting from a side surface of the disc 12 towards the first disc 7. Further, the intermediate disc 15 is provided with two radially extending rods 19 and 20, the former being positioned for engagement with the rod 17 of the first disc 7 and the latter with the rod 18 of the second disc 12. Viewing the illustration given in FIG. 1B, the common shaft 4 together with the rods 19 and 20 is urged in a counterclockwise direction by the spring 6. Therefore, the rod 17 is put in contact with the rod 19 and the rod 18 is also put in contact with the rod 20.

In order to impose a pertinent tension on the strandular materials independently from each other, one embodiment of the mechanism for urging the compensator arms independently from each other is shown in FIG. 2. In the shown embodiment, one end of the first disc 7 is formed as a pulley 40 and the shaft 11 is provided with another pulley 41 fixedly mounted thereon. Both pulleys 40 and 41 are connected via ropes, chains or belts 42 and 43 to given tension sources (not shown), respectively. The tension sources are independent from each other and provide forces to turn the pulleys 40 and 41 counterclockwisely around the axial center of the shafts 4 and 11. This force may be time-functionally adjusted by the tension sources in known manner as the winding operation proceeds. The counterclockwise turning of the pulleys 40 and 41 naturally causes turning of the compensator arms 3*a* and 3*b* in a direction to tension the strandular materials via dancer rolls 2*a* and 2*b*. It should be appreciated that both the tensioning of the strandular materials and the adjustment of the force to effectuate the tensioning are carried out perfectly independently from each other and the strandular materials.

The operation of the tension control device of the present invention will now be discussed.

Assuming that the take-up speed of the first strandular material 1a is accidentally increased, the first compensator arm 3*a* tends to swing clockwise in FIG. 1B. Following this clockwise swinging of the compensator arm 3*a*, the first disc 7 also starts to turn in a clockwise direction and the rod 17 pushes the rod 19 of the intermediate disc 15. This causes clockwise axial turning of the common shaft 4 via the intermediate disc 15 overcoming the counterclockwise urging force by the spring 6. This clockwise turning of the common shaft 4 is sensed by the already explained control unit, which accordingly provides lowering of the rotational speed of the common spindle. This lowering of the spindle rotational speed causes slowing down of the take-up speed of the strandular material. At the moment of this clockwise turning of the common shaft 4 for the compensation, the rod 20 of the intermediate disc 15 turns remotely from contact with the rod 18 of the second disc 12 and the arrangement relating to the second strandular material 1*b* is disconnected from the common shaft 4. Therefore, compensation for the speed fluctuation of one strandular material can be performed with possible minimum tension fluctuation between the strandular materials.

Again assuming that the speed of the second strandular material 1*b* is increased accidentally, the second compensator arm 3*b* swings clockwisely causing a clockwise axial turning of the shaft 11. This causes clockwise urging of the common shaft 4 via rods 18, 20 and the intermediate disc 15. Accordingly, the rotational speed of the common spindle is slowed down by the control unit and the take-up speed of the second strandular material recovers its initial state. At the moment of the clockwise turning of the common shaft 4, the rod 19 of the intermediate disc 15 moves remotely away from the rod 17 of the first disc 7 resulting in the disconnection of the arrangement relating to the first strandular material 1a from the common shaft 4. Therefore, in this case also, the compensation of the speed fluctuation of one strandular material can be carried out without any side effect on the tensioning condition of the strandular materials.

In the actual utilization of the arrangement of the present invention, it was found to be undesirable that both compensator rolls are different in their vertical locational level. Provided that the take-up speed of the second strandular material 1*b* decreases for some reason and the strandular material 1*a* is processed at normal speed, then there will be no change in the rotational speed of the common spindle. Decrease in the take-up speed causes slacking of the second strandular material 1*b* and this slacking causes downward swinging of the second compensator arm 3*b* away from the first compensator arm 3*a*. Because there is no change in the spindle rotational speed, slacking of the second strandular material 1*b* is accumulated as the winding operation proceeds and the second compensator arm 3*b* further moves downward and, finally, it becomes difficult to continue the winding of the second strandular material 1*b*. This trouble is caused by the fact that the respective strandular materials are tensioned independently from each other. So, in the above-described circumstance, it is necessary to make the take-up speeds of the both strandular materials similar to each other. In other words, it is necessary to slow the take-up speed of the first strandular material while increasing the take-up speed of the second strandular material. This mutual approach of the take-up speeds is achieved by increasing the force to urge the first compensator arm 3*a* and by decreasing the force to urge the second compensator arm 3*b*. Increase in the urging force results in the increase in the tension of the strandular material and this tension increase causes hard winding. On the contrary, decrease in the urging force causes soft winding. Thusly the difference between the take-up speeds can be minimized. This is done through relating the urging force of one strandular material to that of the other strandular material to a pertinent extent. Therefore, it is preferable to restrict, to an acceptable extent, the pivotal movement of one compensator arm in relation to the pivotal location of the other compensator arm. The embodiment shown in FIG. 3 is designed so as to meet this requirement.

In the embodiment shown in FIG. 3, the first disc 7 is provided with a supporter arm 21 radially extending therefrom via the bracket 9 and the supporter arm 21 is at its free extremity provided with a magnetic member 22. The second disc 12 is also provided with another supporter arm 23 radially extending therefrom and the supporter arm 23 is at its free extremity provided with a threaded shaft 24. The threaded shaft 24 passes through a threaded hole of the supporter arm 23 and is provided at its one end with a magnet 25 spacedly facing the magnetic member 22. Due to the magnetic attraction between the magnetic member 22 and the magnet 25, a considerable pivotal movement of the compensator arm 3*a* from the pivotal location of the compensator arm 3*b* can be obviated.

In other words, a braking action is exerted on the pivotal movement of the compensator arms by the above-described magnetic arrangement. Therefore, a moment to brake the pivotal movement of the compensator arms is created by the magnetic attraction force of the magnetic arrangement. The magnetic attraction force between the two elements 22 and 25 can be adjusted by changing the distance between them through adjustment on the threaded shaft 24. In this connection, the distance should be so selected that the magnetic braking moment does not exceed the moment created by the minimum but necessary tension to be imposed on the strandular materials. Once the distance is duly settled, the magnetic braking action does not disturb the precise and smooth sensing of the speed deviation of the strandular materials by the arrangement of the present invention.

FIG. 4 shows an embodiment of the arrangement of the present invention in a style actually used in the mill production process, in which embodiment the mechanical construction and its operational features are almost the same with those of the principal embodiment shown in FIGS. 1A, 1B, 2 and 3.

Referring to FIG. 5, another embodiment of the arrangement of the present invention is shown, which embodiment is particularly suited for a case when three or more packages are mounted on a common spindle. Although the shown embodiment is proposed for three packages on a common spindle type winder, the mechanism can be propagated to a greater number of packages on a common spindle. In the shown arrangement, the device includes three speed detecting sets **26***a*, **26***b* and **26***c*, each set having quite similar mechanical construction.

The set **26***a* includes a first disc **27***a* turnably and coaxially mounted on the common shaft **4** via bearings and a second disc **28***a* fixedly and coaxially mounted on the common shaft **4** in a suitably spaced arrangement from the first disc **27***a*. A compensator arm **3***a* is radially fixed to the first disc **27***a* and a dancer roll **2***a* is disposed thereto with a strandular material **1***a* passing therearound. The first disc **27***a* is provided, on its side surface, with a rod **29** *a* projecting towards the second disc **28***a* whereas the second disc **28***a* is provided with a radially fixed rod **30***a*. The common shaft **4** is urged and the two rods **29***a* and **30***a* are placed in a disconnectable contact as in the case of the preceding embodiment. Swinging of the compensator arm **3***a* around the axis of the common shaft **4** is caused by the take-up speed fluctuation of the strandular material **1***a*. This swinging of the compensator arm **3***a* is sensed by the control unit via elements **27***a*, **29** *a*, **30***a*, **28***a* and **4** and the control unit changes the rotational speed of the common spindle so as to compensate for the speed fluctuation of the strandular material.

Braking action on the excessive pivotal movement of the compensator arm **3***a* is created by the embodiment shown in FIG. **6**, wherein the first disc **27***a* is provided with an axially extending magnetic arm member **31***a* whereas the second disc **28***a* is provided with an axially extending arm **32***a* adjustably supporting a magnet **33***a* via threaded shaft **34***a*. The magnet **33***a* is located spacedly facing the free end portion of the magnetic arm member **31***a*. By this arrangement, pertinent braking action is imposed upon the compensator arm **3***a* as in the case of the embodiment shown in FIG. **3**.

In the case of the embodiment shown in FIG. **5**, it is also necessary to provide the arrangement with mechanism for urging the compensator arms independently from each other, which mechanism functions in a manner similar to that shown in FIG. **2**. One embodiment of such mechanism is shown in FIG. **7**, wherein one end of, for example, the first disc **27***a* is provided with a pulley on the periphery of which a termination of a rope, chain or belt is fixed. Another end of the rope or the like (not shown) is connected to given tension source (not shown) and the mechanism functions in a manner basically the same with that in the case of the arrangement shown in FIG. **2**.

It is to be understood that the aforementioned tension sources, control units, and strand winders having multiple packages on a common spindle are conventional, and examples thereof are shown in the aforementioned U. S. Pat. No. 3,350,022.

What is claimed is:

1. In a winding machine having a plurality of packages mounted on a common spindle for winding a plurality of individual strands having its speed controlled by a control unit, an individual strand speed compensator device comprising

a rotatable first shaft connected to the control unit for changing the winding speed by rotation of said first shaft;

biasing means connected to said first shaft to apply a turning force tending to rotate said first shaft in a winding speed increasing direction;

a plurality of compensator arms, one arm for each strand, each said arm extending radially with respect to said first shaft and freely rotatable thereabout;

an individual first engaging member connected with each said arm and adapted to rotate therewith;

an individual compensator roll mounted at the end of each arm for an individual strand to pass thereover;

individual tension means connected respectively to each said compensator arm to apply a predetermined rotative tension; and

a plurality of second engaging members fixedly connected to said first shaft, an individual one of said second engaging members being engaged by one of said individual first engaging members upon rotation of the respective compensator arm to thereby cause rotation of said first shaft as an individual strand increases in speed.

2. A device according to claim **1** in which a first disc is provided, said first disc being mounted to rotate freely on said first shaft, and one of said compensator arms being connected thereto to provide the free rotation thereof.

3. A device according to claim **2** in which a second shaft is axially aligned with said first shaft, a second disc is fixedly mounted on said second shaft and includes one of said first engaging members mounted thereon, and an intermediate disc located between said individual first disc and said second disc is fixedly mounted on said first shaft whereby rotation of said first shaft is provided via said intermediate disc by rotative engagement of said individual first and second engagement members.

4. A device according to claim **3** in which each one of said first engaging members comprises a rod extending from a side surface of said first disc, and each one of said second engaging members comprises a rod extending radially from said intermediate disc.

5. A device according to claim **2** in which said tension means comprises individual pulleys having tension thereon connected respectively to individual first discs.

6. A device according to claim **3** in which first magnetic means is connected to each of said first discs at a radial distance from said first shaft, second magnetic means is connected to each of said second discs at said same radial distance and at a predetermined spacing from said first magnetic means, said spacing being adjustable to provide a braking effect on the rotative movement.

7. A device according to claim **1** in which a plurality of first discs are provided corresponding in number to said compensator arms, each individual first disc being mounted to rotate freely on said first shaft, said respective compensator arm is connected thereto to provide the free rotation thereof, and a plurality of second discs are provided, each said second disc fixedly mounted on said first shaft, and each one of said second engaging members is respectively mounted on an individual second disc.

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