REVERSIBLE INDIVIDUAL DRIVE FOR SPINNING SPINDLES

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The present invention relates to a reversible individual drive for the spindles of spinning machines and doubling frames, whereby each spindle is driven by an endless short belt in contradistinction to conventional spindle drives in which a plurality of spindles is driven by an endless belt which, naturally, is relatively long.

Individual spindle drives have been proposed in which each spindle is driven by a relatively short endless belt, the belts being individually driven by pulleys mounted on a drive shaft. These conventional drives include a tension pulley and a belt diverting pulley. The latter is needed because the rotation axes of the spindle and of the drive shaft are normal relative to each other. In one conventional mechanism the diverting pulley is placed on the common drive shaft which permits use of a relatively large diverting pulley. Since the latter must rotate in opposite direction of the drive shaft, its bearing is heavily strained. In another conventional device, the diverting pulley is mounted on a stationary support which is connected to the machine frame. In this case, the diverting pulley must be small and must rotate at high speed, necessitating a relatively expensive roller bearing. In both cases, the diameter of the tensioning pulley must correspond to the diameter of the whare, i.e., has a small diameter and operates at a speed which is approximately the same as the speed of rotation of the spindle. This necessitates a high-grade bearing which is expensive and, if it requires greasing, frequently causes difficulties.

In the aforementioned conventional drives, the direction of movement of the belt is changed four times so that the belt is very frequently bent, per minute unit, whereby its life is reduced.

It is an object of the invention to provide an individual reversible drive for the spindles of spinning machines and doubling frames which avoids the difficulties experienced with conventional individual drives. The drive according to the invention includes a common drive shaft mounted on the machine frame and provided with a drive pulley for each spindle, a tensioning pulley being provided for each spindle. Each tensioning pulley is mounted at the end of a pin whose axis is placed at a slant with respect to the common drive shaft and as close thereto as possible. This pin is swingable on a stationary axis which is placed at a slant relative to the rotation axis of the tension pulley.

The rotation axis of the tension pulley is so slanted with respect to the drive shaft that the portion of the circle formed by the belt on the tensioning pulley is located in a plane which is tangent to the portion of the circle formed by the belt on the whare as well as to the portion of the circle formed by the belt on the driving pulley. By using the tension pulley for tensioning as well as for reversing the driving belt, whereby the diameter of the tension pulley is substantially equal to that of the drive pulley, only one low-speed bearing is required in contradistinction to conventional devices which require two high-speed bearings so that the friction losses caused by the drive according to the invention amount to about one half of that of conventional drives.

The novel features which are considered characteristic of the invention are set forth with particularity in the appended claims. The invention itself, however, and additional objects and advantages thereof will best be understood from the following description of an embodiment thereof when read in connection with the accompanying drawing, in which:

Fig. 1 is a perspective diagrammatic illustration of the geometrics of the device according to the invention.

Fig. 2 is a cross sectional view of a spindle frame and showing one spindle drive according to the novel run.

Fig. 3 is a top view of the spindle drive shown in Fig. 2.

In Fig. 1, all bodies of rotation are diagrammatically represented by two-dimensional discs around which a belt, for example a cord, represented by a line, is laid. Numerical 1 designates a line representing the normal axis of a spindle which is normal to a horizontal plane B. The spindle is provided with a whare disc 2 which is tangent, at point W₂ to the horizontal line S along which the horizontal plane B intersects a vertical plane A. Numerical 3 designates a line representing the rotation axis of the drive shaft of the spinning machine which is normal to the plane A and spaced from the plane B. A pulley 4 is mounted on the drive shaft. The circle representing the pulley 4 is tangent to the line S at point T₁. A disc 5, located in a plane C, represents a tension pulley and diverting or reversing pulley around which the drive cord is laid. The rotation axis of the pulley 5 is placed at a slant with respect to the axes 1 and 3. The cord leaves the disc 2 at point W₂ and runs along the line S to point T₁ where the cord engages the pulley 4 and runs thereon between points T₁ and T₂. The cord continues to move along a line d to a point U₁ where it runs onto the pulley 5 which is left by the cord at point U₂. Therefrom the cord runs on a straight line e to point W₁ on the circle representing the whare 2. The course of the cord is ideal if the circles K₂ (whare), K₄ (drive pulley), and K₅ (tension pulley), forming part of the course of the cord, remains in the position shown in Fig. 1, also when the rotation of the spindle is reversed.

This is only the case, if the running-on and running-off points of the cord on the individual discs are located in the same radial planes as the discs and if the running-on and running-off portions of the cord are tangent to the discs. To accomplish this, the lines S and d must be tangent to K₄ in the plane A which is normal to the axis 3; the lines S and e must be tangent to K₅ in the plane B which is normal to the axis 1; and the lines e and d must be tangent to the circle K₅ in the plane C which is normal to the axis 6. Under the aforesaid conditions, the lines e and d, which are both in the plane C, intersect in a point P. Line e is also in the plane B and the line d is also in the plane A. Since the line S is common to the planes A and B and lines e and d coincide with the lines of intersection of plane C and plane B and of plane C and plane A, point P is in the line S.

Therefore, at ideal running conditions, all straight portions of the cord coincide with lines which intersect at the point P. The latter moves along the straight line S between T₁ and P, depending on the angle α of contact of the cord with the disc 4 which angle can be changed between 0° and 90°, the point P representing the intersection of a tangent to the circle K₄ which tangent is at right angle to the line S. The required length of the cord depends on the position of point P.

After choosing the diameter of the circle K₅, which is preferably approximately as great as the diameter of the circle K₄ and greater than the diameter of the whare, a suitable location of point P must be found. The tangents
extending from point P to the point W₁ of the circle K₈ and to the point T₀ of the circle K₄ define the plane C. The center Z of the circle K₈ is located on the line W bisecting the angle formed by the lines e and d. Point Z defines the location of the rotation axis of the disc 5 which axis is normal to the plane C. If the cord runs around a cylinder rotating on the axis 6 and having a diameter corresponding to that of the disc 5, the cord will automatically place itself on a circle K₆ which is so located that the three lines including the three straight line runs of the cord intersect in point P. If the latter moves, due to a change of the length of the cord, the center Z must move along a three-dimensional curve p and the axis 6 must generate a three-dimensional surface in order to satisfy the requirements of exact run of the cord. The curve p and the position of the axis 6 can be found empirically when assuming different locations of the point P. It has been found that for all practical purposes it is sufficient, if the surface generated by the axis 6 corresponds to a rotational hyperbolic surface, i.e., the axis 6 must swing on an axis 6' which is slanted with respect to the axis 6. The distance between the axes 6 and 6', their relative angular position and the position of the axis 6' in space depend on the chosen geometric conditions.

For simplicity's sake, it has been assumed in the foregoing discussion that the wharve, the driving pulley and the tension pulley are cylindrical. It is obvious that the running surface of the wharve can be axially curved. In that case, the circle K₆ must represent the largest diameter circle of the wharve portion of the spindle. The same is true for the driving pulley 4 but not for the tension pulley, because the latter does not rotate on a stationary axis.

Figs. 2 and 3 schematically illustrate a mechanism which is based on the above described stereometric considerations.

Referring more particularly to Figs. 2 and 3 of the drawing, numeral 7 designates a spindle frame to which a stationary support 8 is connected for rotatably supporting a spindle 9. The latter is provided with a cylindrical wharve 10 which is driven by an endless belt 11 extending partly around a drive pulley 12 and a tension pulley 13.

A plurality of equally spaced bearings 15 for the drive shaft 16 are made fast on the spindle frame 7 by bolts 14. A cylindrical drive pulley 12 is mounted on the shaft 16 for each spindle. The tension pulleys 13, which have cylindrical belt-engaging surfaces 17, are placed as closely as possible to the respective drive pulleys 12. Each tension pulley is provided with a trunnion 18 which rotates in a bearing supported by a carrier 19 which is supported by a rod 20 rigidly connected thereto. The rod 20 is rigidly connected to a support 21 mounted on a shaft 22. The latter is rotatably supported in a bracket 24 mounted to a lower flange 23 of the spindle frame. The shaft 22 is secured by means of collars 25 and 26 against axial movement relative to the bracket 24. A coil spring 27 wound around the shaft 22 and having one end 28 extending into a bore 29 in the support 21 and having the other end, not shown, fixed to a stationary part of the mechanism, provides the torque required for swinging the tension pulley 13 to tension the belt 11. Numeral 30 designates a cover for enclosing the spindle drive mechanism.

I claim:

1. A reversible individual drive for the spindles of spinning machines and doubling frames, including a spindle support, a drive shaft, a drive pulley mounted on said shaft for each spindle, each spindle having a wharve, a tension pulley placed at the far side of said shaft with respect to said wharve and as close as possible to said shaft, a pin rotatably supporting said tension pulley and spaced from and placed at a slant with respect to said drive shaft, a carrier for said pin, said carrier being swingable on an axis spaced from and placed at a slant with respect to the rotation axis of said tension pulley, and an endless belt extending partly around said drive pulley, said tension pulley, and said wharve.

2. A reversible individual drive as defined in claim 1, including a support swingable on an axis which is spaced from and placed at a slant with respect to said pin and connected to said carrier for supporting the latter.

3. A reversible individual drive according to claim 2, wherein said support includes a torsion spring for swinging said carrier and said tension pulley in a direction for increasing the tension of said belt.

4. A reversible individual drive as defined in claim 1, wherein the diameter of said tension pulley corresponds substantially to the diameter of said drive pulley and is greater than the diameter of the wharve.

5. A reversible individual drive as defined in claim 1, wherein said tension pulley has a cylindrical surface.

6. A reversible individual drive as defined in claim 1, wherein said tension pulley and said wharve individually have a cylindrical surface.

7. A reversible individual drive as defined in claim 1, wherein said tension pulley and said drive pulley individually have a cylindrical surface.

8. A reversible individual drive as defined in claim 1, wherein the plane including the circle on which the belt extends around said tension pulley is tangent to the circle on which said belt extends around said wharve and to the circle on which said belt runs on said drive pulley.

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