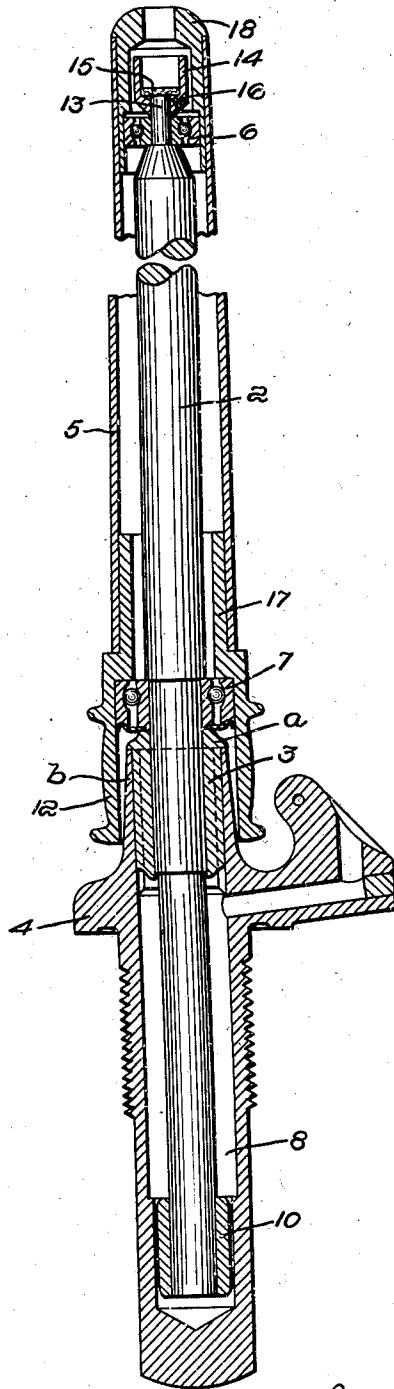


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SPINNING AND TWISTER SPINDLE

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SPINNING AND TWISTER SPINDLE

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This invention relates to spindles of the type used in cotton spinning and twister frames.

The spindles universally used in machines of this character include a revolving shaft or blade supported vertically in a suitable base and equipped with a whirl to receive the tape by means of which the blade is driven. The yarn package or bobbin rests on the whirl and is driven in unison with it. These spindle structures are manufactured with a high degree of accuracy, and so long as the speeds at which they are run are not too high, and the loads which they are required to carry are not too great, they operate very satisfactorily. In recent years, however, there has been a constant tendency to increase the speeds of operation of such spindles, and also to use larger yarn packages or bobbins, with the object of increasing the production per spindle, and these factors have developed the weaknesses of this type of spindle inherent in the fact that the load is supported in a badly overhung position.

This mechanical fault of such spindles was recognized some years ago and another type of spindle was suggested in which the blade is supported in a fixed or stationary position and a sleeve adapted to carry the bobbin is mounted on the "dead" spindle to revolve around it. Such a construction has the mechanical advantage over the live spindle of permitting the use of a bearing at the top of the blade as well as one near the base to support the sleeve both above and below the load. Theoretically these constructions should operate very satisfactorily and in practice they do so under certain conditions, but they are subject to failures, the reasons for which have been extremely obscure.

The object of this invention is to overcome the defects in spindles of this type and to devise a thoroughly satisfactory construction.

The nature of the invention will be readily understood from the following description when read in connection with the accompanying drawing, the single figure of which is a longitudinal, vertical section of a spindle constructed in accordance with this invention.

The construction in the drawing comprises a spindle 2 pressed into a bolster 3, the latter having a flange a which rests on the upper end of an extension b of the spindle base 4. Mounted to revolve around the upper portion of the blade 2 is a sleeve 5 adapted to removably support a bobbin thereon, upper and lower bearings 6 and 7, respectively, being provided to support the sleeve for rotation.

So far as the general organization above described is concerned, it will be evident from what has been said above that such an arrangement has been proposed heretofore. But, as stated above, these constructions have not proved satisfactory and, so far as I am aware, they have never gone into commercial use in this country.

The construction shown in the drawing differs in two important respects from the prior art arrangements, as follows:

(1) The stationary spindle 2 is mounted for limited freedom of movement relatively to the base so that it is free to adjust itself automatically into a stable running position, and

(2) The bearings 6 and 7 have provision for self-alignment.

As above stated, the bolster 3 is suspended on the top of the extension b of the spindle base 4, but it is keyed to this extension so that it cannot revolve relatively thereto. In addition, it is made slightly smaller by, say, two or three thousandths of an inch in diameter than the bore of the base in which it fits, so that its bearing area in the extension permits it to have a slight swinging movement about this area as a fulcrum. The blade extends downwardly below the bolster into the oil well 8 formed in the base and a sleeve 10 pressed on to the lower end of the blade is made sufficiently smaller in external diameter than the internal diameter of the portion of the well in which it is positioned so that the amplitude of the swinging movement above referred to is limited by the engagement of this sleeve or collar with the walls of the oil well. The amount of this clearance in a typical instance is from, say, ten to fifteen thousandths of an inch at all points around the collar.

With this arrangement the blade 2, instead of being secured rigidly to the base, as in prior art constructions, is allowed to swing substantially freely about a fulcrum at the upper end portion of the base so that it can readily find, and adjust itself into, a stable running position. A relatively slight degree of freedom appears to be all that is necessary for this purpose, such limits as those above mentioned being suitable for spindles of the ordinary dimensions, but some such degree of freedom is necessary to prevent the spindle from vibrating excessively at high speeds. The gyratory or vibratory movements of the spindle which it makes in finding its running position are yieldingly resisted or dampened by the oil in the base. Such resistance also is an important factor in contributing to the smooth operation of the spindle.

Preferably ball bearings, or some equivalent anti-friction bearings, such for example, as needle bearings, are used at the points 6 and 7. The particular bearings shown are ball bearings of the self-aligning type, the inner races being seated on portions of the stationary spindle 2 and the balls having the usual running fit with them, while the outer races are pressed into the bore of the sleeve 5 and they have a limited degree of endwise freedom of movement relatively to their respective sets of balls. These thus are typical self-aligning ball bearings.

Preferably the lower bearing is seated as close to the whirl 12 as is practical, and the fulcrum area above referred to is substantially centered vertically with reference to the tape engaging surface of the whirl so that the line of pull of the driving belt or tape will be substantially in the plane of the fulcrum about which the spindle has the limited degree of swinging movement above described.

In order to accommodate the upper bearing 6 the spindle preferably is reduced in diameter to provide a cylindrical tip 13, and the inner race of the ball bearing 6 has a close fit on this tip and rests on the shoulder formed at the junction of said tip with the larger portion of the blade immediately below it. Preferably, also, an oil cup 14 fits on to the tip 13 immediately above the bearing and has a disk of felt or equivalent fibrous material 15 in it so that oil introduced into this cup seeps slowly through the disk and through a hole 16 in the bottom of the cup, finally finding its way into the bearing 6. Any surplus oil will flow from this bearing down the stationary blade 2 to the lower bearing where it will lubricate the latter.

As shown, the main body of the sleeve 5 is fitted tightly over an extension of the whirl 12 so that the two revolve as a unit, and a shoulder 17 is formed on the extension of the whirl to act as a stop for the lower end of the tube, bobbin or yarn core engaging the sleeve. At its upper end the sleeve 5 telescopes over the lower portion of the cap or plug 18 in which the bearing 6 may be conveniently fitted, and the cap has a central aperture in its upper end to permit the introduction of lubricant into the cup 14.

As above stated, a serious difficulty encountered in running experimental spindles of the general type here described and equipped with ball bearings mounted in the sleeve above and below the center of mass of the sleeve and its load, has been the failure of one or both of these bearings after a relatively short period of operation at the high speeds for which they are intended say, for example, in the neighborhood of 15,000 R. P. M. Usually the upper bearing is the one causing the trouble, the lower bearing being comparatively reliable.

Another surprising fact developed by these experiments is that high grade bearings manufactured with great care and precision have proved more troublesome in this respect than have the less expensive bearings. This fact led to the trial of a self-aligning bearing at the upper end of the sleeve and that was found to operate entirely satisfactorily. It was then found that still better results were obtained when self-aligning bearings were used at both ends of the sleeve. A needle bearing at the upper end of the sleeve also has proved satisfactory, but one ball bearing or the other must be relied upon to take the vertical thrust of the load, and since the lower bearing can be made larger and heavier, it is preferred

to use it for this purpose as well as for radial support of this end of the sleeve in its centralized relationship to the blade.

This construction has proven very satisfactory even at high speeds and with heavy loads.

The fact that such a construction overcomes the objections heretofore experienced with spindles of this general type having been definitely established, it is now possible to find a reason for this fortunate result, or at least an explanation for it, which was not discernible prior to the accomplishment of the fact. The best explanation which I am able to advance is that notwithstanding all the care customarily employed in manufacturing these spindle structures, there are minor inaccuracies and manufacturing errors in them. It is probably true that neither any spindle blade nor any spindle sleeve is exactly straight. At some point in the rotation of the sleeve the departures from correct alignment so introduced become cumulative and they apparently produce a vibratory action or a tendency to bind which is quickly felt if precision bearings are used. Such a condition, therefore, accounts for the failure of bearings of this type and for the more favorable operation of ball bearings of the cheaper kinds, even though the results produced with the latter were not satisfactory. Because the self-aligning bearings have the capacity to accommodate the cumulative effects of these minor inaccuracies they operate satisfactorily where the other types have failed.

While this is the best explanation of the favorable action produced by the use of self-aligning bearings which I am able to give at this time, it should be understood that I do not limit myself to this theory of operation.

The mounting of the spindle blade in the base so that it has sufficient freedom of movement to enable it to find a stable running position automatically is a factor vitally important to successful operation.

While I have herein shown and described a preferred embodiment of my invention, it will be evident that the invention may be embodied in other forms without departing from the spirit or scope thereof.

Having thus described my invention, what I desire to claim as new is:

1. A spindle structure comprising an upright, rigid non-rotative spindle blade, a sleeve encircling said blade in concentric relationship thereto, a whirl rigid with said sleeve to revolve therewith as a unit, said unit being adapted to removably support a bobbin, two sets of bearings supporting said unit near opposite ends thereof for rotation around said blade, said bearings being mounted on said blade above and below, respectively, the center of mass of the unit and the load carried by it, the upper of said sets of bearings being self-aligning, and means flexibly supporting said blade to enable it to move freely with said unit during operation while the latter finds a stable position of rotation.

2. A spindle structure comprising an upright, rigid non-rotative spindle blade, a sleeve encircling said blade in concentric relationship thereto, a whirl rigid with said sleeve to revolve therewith as a unit, said unit being adapted to removably support a bobbin, two sets of self-aligning bearings mounted on said blade and supporting said unit near opposite ends thereof for rotation around the axis thereof, and a base on which said blade is mounted for free but limited swinging movement enabling it to find automati-

cally a stable running position suited to the requirements of the unit and the load which it carries.

3. A spindle structure comprising an upright, rigid non-rotative spindle blade, a sleeve encircling said blade in concentric relationship thereto, a whirl rigid with said sleeve to revolve therewith as a unit, said unit being adapted to removably support a bobbin, two bearings mounted on said blade and supporting said unit near opposite ends thereof for rotation around the blade, and a base in which said blade is mounted for free but limited swinging movement about a fulcrum adjacent to said whirl, whereby the blade and said unit are enabled to adjust themselves automatically into a stable running position depending upon the requirements of the unit and the load mounted on it, said bearings having sufficient degree of clearance to enable them to adjust themselves automatically to accommodate minor manufacturing errors in alignment of the spindle and sleeve.

4. A spindle structure comprising an upright, rigid non-rotative spindle blade, a sleeve encircling said blade in concentric relationship thereto, a whirl rigid with said sleeve to revolve therewith as a unit, said unit being adapted to removably support a bobbin, and two sets of self-aligning anti-friction bearings mounted on said blade and supporting said unit near opposite ends thereof for rotation around the axis of said blade, each of said bearings including inner races seated on a lateral surface of said blade and a cooperating outer race carried by said unit, and a base in which said blade is mounted for free but limited swinging movement about a fulcrum located within said whirl enabling it to find automatically a stable running position suited to the requirements of the unit and the load which it carries, the lower of said bearings being mounted closely adjacent to said fulcrum.

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