

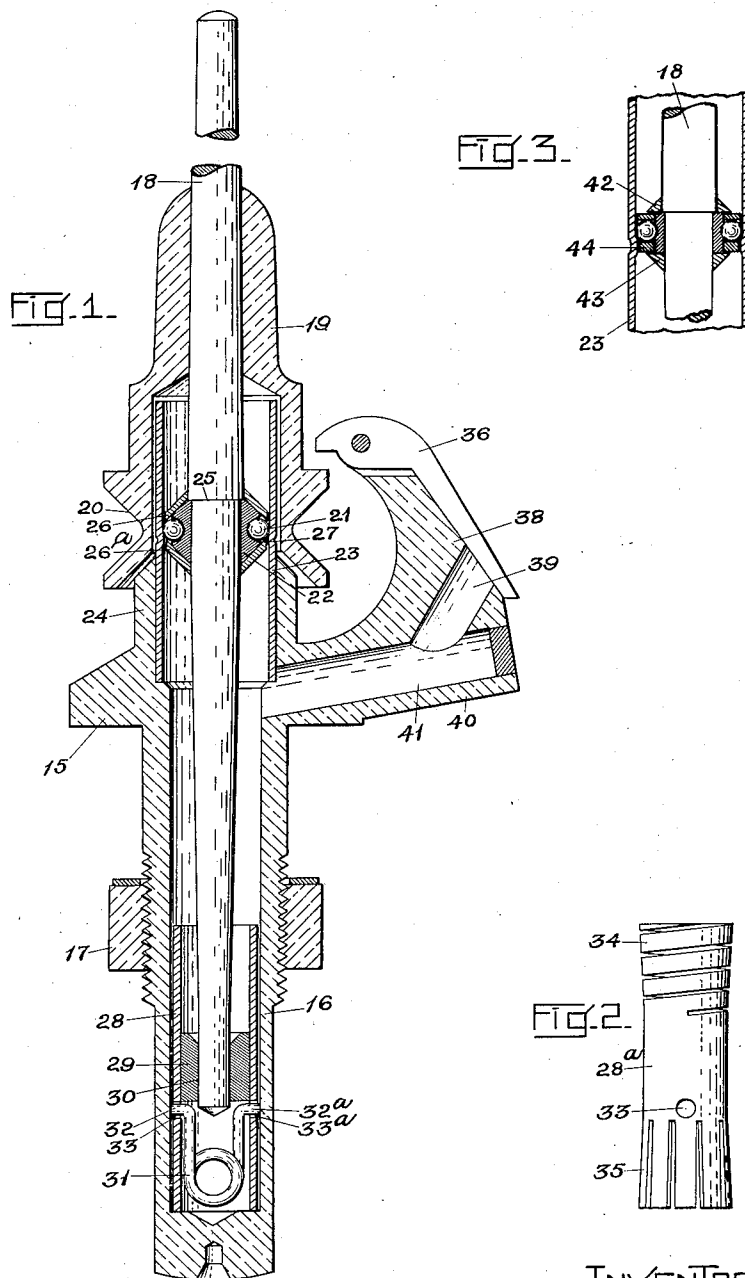
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SELF OILING BALL BEARING SPINDLE

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SELF-OILING BALL-BEARING SPINDLE.

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The present invention relates to spindles of the sort used in machines for spinning or twisting yarn, thread, and similar filaments composed of fibers twisted together into a long strand, whether such strand or filament is finished yarn in condition for weaving or for being twisted together to form composite yarn or thread, or is finished sewing thread, or is a strand in a semi-finished state requiring one or more further spinning or twisting operations to bring it into the finished condition. The invention is particularly concerned with improvements in ball bearing spindles and means for oiling the ball bearings of such spindles while, at the same time, reducing oil drag to the minimum and preventing oil from leaving the bearing and being thrown off by the rotating spindle whirl; and is further concerned with improvements in the lower bearing and cushion for the blade of such a spindle.

The objects of the invention are to provide, in connection with a spindle blade having a lateral ball bearing to determine its position in the base and a body of spindle oil below such bearing, a means for raising oil to the bearing from a lower level and means for retaining oil at the ball bearing and preventing the oil so raised from reaching the whirl and being thrown therefrom; to provide a cushioning sleeve for the foot of the blade containing a bearing so located that the lateral pressure applied by the blade foot on the sleeve tends to maintain the latter in alinement with the blade; and to provide in connection with such sleeve a means for locating it against rotation while leaving it free for lateral movement.

I am aware that ball bearing spindles have heretofore been proposed in which the ball bearing is located above the level of the oil body in the base and oil is raised by the blade to lubricate such bearing, but in the running of such spindles the oil raised by the blade through the rapidly revolving balls is atomized, and charges the adjacent air with oil vapor, which, through the circulation of air induced by the rapidly rotating parts, finds its way out of the oil chamber and is thrown off by the whirl, also condensing, when the spindle is at rest, on the inner portion of the whirl and the outer part of the base. A rapid wasting of oil thus occurs, which soon causes

the spindle to run dry, with resulting wear and shortening of the life of the wearing parts, besides damaging the yarn. I have heretofore devised a ball bearing spindle in which adequate lubrication of the ball bearing is secured by submerging it in oil, and have secured patents of the United States No. 1,253,351, dated January 15, 1918, and No. 1,338,904, dated May 4, 1920, covering the same. With such spindle the oil causes a frictional drag opposing travel of the balls and movement of the other rotating parts.

The overcoming of this resistance requires a substantial expenditure of power owing to the high speed at which these spindles are driven, even though the oil used is of relatively slight viscosity.

In the present invention the oil drag is substantially reduced by making the spindle so that the oil level is kept well below the ball bearing and wide spaces are provided between the blade and the stationary enveloping parts of the base; while the blade and attached parts are given sufficient taper to raise oil from the lower oil level to the bearing when running at the required speed. The rotating and stationary parts adjacent to the balls are brought so close to one another, both above and below the balls, and have a sufficient length in the axial direction, that the pressure and flow to the bearing of the oil which is raised by the tapered blade is substantially limited and an unbroken sealing film of the spindle oil is held in the narrow annular space between such parts above the balls, and retained there so tenaciously that the limited pressure of the oil rising from beneath is unable to displace it. Preferably the propinquity above mentioned of the parts above the balls is obtained by forming or securing on the blade an outwardly projecting annular member, and preferably also the enveloping structure of the spindle base rises perpendicularly beyond such member. The oil film thus retained above the balls seals the air contained in the chamber beneath and prevents the oil and air set into more or less rapid motion and circulation by the revolving parts from passing out of the spindle.

The lower end of the blade runs in a lower bearing preferably of hardened steel, that the length of the bearing may be shortened

to lessen friction, and still maintain the wearing life; or a ball bearing, similar to the step bearing of my Patent No. 1,338,904, or a plain thrust bearing may be used. This lower bearing is contained in a cushioning sleeve and so positioned in the sleeve that the axis of the sleeve will maintain coincidence and alignment with the axis of the blade. I further provide a locking or clutch device, preferably a spring having lateral end portions protruding through relatively large holes in the wall of the sleeve and pressing against the wall of the socket of the base, forming a simple lock, that the sleeve may not revolve and yet be free to move laterally in its cushioning capacity.

The spindle having these or equivalent characteristics, together with the mechanical structures and elements which are features of these characteristics, constitutes the invention which I claim here and which I shall now proceed to describe in full detail, reference being had to the drawings forming a part of this application.

In the drawings;

Figure 1 is a vertical central section of a spindle representing one embodiment of my invention;

Fig. 2 is a detail elevation of a modified form of step sleeve showing two methods of spring construction;

Fig. 3 is a vertical central section of a modified form of ball bearing.

Like reference characters designate the same parts wherever they occur in all the figures.

I shall confine my description of the parts which are common to this invention and to the spindle disclosed in my above named prior Patents, Nos. 1,253,351 and 1,338,904, to a brief catalogue of such parts, using the same reference characters. 15 is the spindle base, and 16 the tubular extension thereof adapted to pass through the spindle rail of the spinning frame, forming a socket to contain the lower part of the spindle blade and a body of spindle oil, and having a nut 17 threaded externally upon it to clamp it to the rail. 18 is the blade or spindle proper, 19 the whirl fixed on the blade, and 20 the pulley with which the whirl is provided to receive the driving band whereby the blade is rotated. 21 represents the balls, 22 the inner race, fixed to the blade, and 23 an outer ball race sleeve fixed to the base, constituting the lateral ball bearing which centers the blade and sustains it against the pull of the driving band; this bearing being preferably in the same lateral plane with the line of pull of the driving band.

The blade is designed with an upwardly enlarging taper of such value that, due to centrifugal force when rapidly rotating and the tendency of oil to cling to its surface, it will raise oil from a level below the bearing

up to the bearing in sufficient measure for adequate lubrication. In the form of the bearing shown in Fig. 1, retaining and filling pieces 26 and 26^a are fitted and applied to the blade immediately above and below the series of balls and extend from the blade toward the sleeve 23, preferably on a downward inclination with respect to the upper retainer and on an upward inclination with respect to the lower retainer, into such close proximity to the sleeve that the intermediate spaces are narrow enough to secure the effects stated in the introductory part of this specification. I have found in practice that a width of approximately five thousandths of an inch is suitable and effective for thus retaining the light oils which are used with the fast running spindles in the spinning art, while permitting whatever lateral angular movement of the blade may be necessary to center its load when rotating at high speed. The inclination of the retainers, above mentioned, by enabling their axial length at the outer circumference to be extremely short, contributes to this end. However, it is to be understood that I am not limited to the exact width above named. An equivalent, but specifically different filler or retainer is shown at 44 in Fig. 3, and is later described in detail.

The stationary outer sleeve 23 of the ball bearing here shown is of uniform diameter from top to bottom, except for an indented shoulder 27 on which the balls rest and support the blade; but when a step bearing, such, for instance, as the one shown in my Patent No. 1,338,904, which supports the weight of the blade and bobbin thereon, or a plain thrust bearing, is used in place of the specific lower bearing here shown, as it may be, the indented or offset shoulder 27 may be omitted.

28 is the sleeve which contains the lower bearing 29 for the blade. It is wholly disengaged from the base, except that it rests on the bottom of the socket therein, and is so mounted as to be capable of a lateral cushioned movement of the lower end of the spindle by being of smaller diameter than the interior of the extension 16. 40 is the arm at one side of the base having a passage 41; and 38 is a post, having a passage 39 constituting an oil inlet tube, rising from the arm and carrying the doffer guard 36 which is made to provide also a cover for the inlet tube passage. These passages admit oil into the interior of the base and allow the oil to rise in the base up to the level of the lowest point in the orifice of the inlet tube 39, which is below the ball bearing. This is the maximum height to which oil can rise in the base and is reached only when the oil supply is replenished. Thus the oil level cannot rise high enough to sub-

merge the bearing and is normally at a considerable distance below it.

The oil may be maintained at a level below the ball bearing and raised by centrifugal force and the upwardly enlarging taper of the blade to the narrow space between the moving parts of the ball bearing and the outer race without loss of oil. The oil film at the bearing above the balls forms an air tight seal to the action of the oil and air circulating below the bearing, thereby preventing any oil-charged air from escaping. 44, Fig. 3, shows a ball separator so constructed as to form a filler, being a ring perforated for the balls with the metal set over the holes to keep the balls from escaping when the blade is removed from the base, and is retained in position over the inner race by rings 42 and 43. Sleeve 28 is so constructed that it may be of short length and have a large, open, interior, and is secured from rotation, but not from free lateral movement bodily in all directions, by spring 31 having ends 32 and 32^a passing loosely through holes 33 and 33^a in sleeve 28, which holes are enough larger than the ends of the spring to permit such movement of the sleeve, and pressing against the inner wall of tube 16. Sleeve 28 contains the lower bearing 29 which is substantially shorter than the sleeve and so located in the sleeve that the center of its lateral bearing with the blade is a little below the longitudinal middle point of the sleeve, so that the action of the sleeve against the resistance of the cushioning body of oil will tend to incline it in the measure needed to maintain alignment with the blade when shifted sidewise by inclination of the blade in centering an eccentric load. In Fig. 2 are shown two methods of forming springs to assist in cushioning the equivalent step sleeve 32^a, one by cutting the end of the sleeve into a spiral spring 34, and the other by slotting the sleeve to form a series of lever springs 35. In using a ball bearing or plain thrust bearing step the same location for alignment is to be observed.

In addition to all of the advantages and useful features set forth in my patents before referred to, this improved spindle includes the following:—

1. A much lighter running spindle is obtained through reduction of friction by having a low level of oil in the base.

2. A film of oil is raised to the ball bearing from a low oiling level, and constantly maintained there.

3. A film of oil is retained at the ball bearing and above the oiling level and forms a seal to the air in the chamber below the bearing, where the circulation of oil, air and oil vapor takes place.

4. No oil stop above the ball bearing is

required, and as the bearing is not submerged in oil, there is no churning action while doffing, neither is there oil about the blade above the bearing to climb up to the whirl.

5. The cushioning sleeve is short, and is so balanced in resistance as to act in line with the blade; leaving a much larger oil reservoir with a resultant lessening of oil drag, as the closer the housing to the blade the more the breaking up of the molecular body of the oil. There is also a saving in manufacturing cost.

6. The simple means of locking the cushioning sleeve against rotation by a spring as set forth, saves the expense of key and keyway, and also retains the sleeve in position when the spindle is handled, set, cleaned, etc., by the working employees in the mill.

What I claim and desire to secure by Letters Patent is:

1. A spindle comprising a stationary supporting structure having a socket adapted to contain spindle oil, a rotatable spindle blade extending into said socket and supported therein, and a lateral ball bearing above the oil in the socket comprising a series of balls interposed between the blade and the supporting structure, the rotating and stationary parts above the balls being so close together and so constructed as to retain a sealing film of spindle oil in the space between them, preventing escape of oil from the chamber beneath when the spindle is in operation.

2. A spindle comprising a stationary supporting structure having a socket adapted to contain spindle oil, a rotatable spindle blade extending at its lower portion into the socket below the normal oil level therein and constructed to raise oil to the after-mentioned ball bearing when rotated at normal speed, and a lateral ball bearing above the normal oil level comprising a series of balls interposed between the blade and the supporting structure, and means rotatable with the blade and projecting therefrom above the balls into such close proximity with the surrounding structure as to prevent upward passage of oil through the intermediate space from the chamber beneath, under the forces acting when the spindle blade is in operation.

3. A spindle comprising a supporting structure forming an upright socket constructed to hold a body of spindle oil in its lower portion, a rotatable spindle blade supported in said socket and extending at its lower part into said body of oil, a ball bearing comprising a series of balls interposed between the blade and the enveloping socket structure, below the upper extremity of such socket and above the normal oil level, the spindle having provisions for causing oil

to be raised from the oil body to the bearing, rotating and stationary parts above the balls being so close together as to retain a sealing film of spindle oil in the intervening space, and the stationary socket structure forming the outer wall of such space rising perpendicularly higher than the rotating inner wall of the film retaining space, said sealing film preventing the escape of oil.

4. A spindle comprising a non-rotatable supporting structure having an interior socket formed to hold spindle oil, a spindle blade substantially smaller in diameter than said socket contained therein at its lower portion and extending into the oil space thereof, a lateral ball bearing comprising a series of balls interposed between the blade and the surrounding structure above the normal oil level, the blade being constructed to raise oil from a lower level to said bearing, and means rotatable with the spindle blade arranged above the balls and projecting into such close proximity to the surrounding socket structure as to retain in the intermediate space an unbroken film of spindle oil, the socket structure rising vertically beyond said means and said means having a receding formation from the socket structure toward the blade; the sealing film so retained serving to prevent escape of oil from the ball bearing and from the space beneath by the forces acting when the spindle is in operation.

5. An upright spindle, comprising a supporting structure forming a non-rotating socket arranged to hold a body of spindle oil in its lower portion, a rotatable spindle blade supported in said socket and extending from below the level of said body of oil out of the supporting structure, the portion of the blade rising from the oil body being formed with an upwardly enlarging taper capable of raising oil when the blade is rotated at normal speed, and a series of balls interposed between the blade and the embracing walls of the socket above maximum level of the body of oil in position to receive oil so raised, the spaces between the stationary and rotating parts above and below the balls being both adapted to receive oil and so constricted as to retain oil, the oil film in the constricted upper space forming a seal to stop the passage of oil and air from beneath, and the film in the lower space being above the body of oil and limiting the supply of oil raised and delivered to the balls by the tapered blade.

6. A spindle having a base with a depending socket portion closed at its lower end adapted to contain spindle oil, a spindle blade arranged at its lower end portion in said base, an upper bearing in the base for said blade, a cushioning sleeve independent of said upper bearing supported on the bottom of the socket with freedom for lateral

movement bodily at its upper, as well as its lower, end and having a bearing for the lower end of the blade, said bearing being so located that its center of lateral bearing pressure is at a point below and near the middle of the length of the sleeve such that the sleeve is maintained in axial alignment with the blade when shifted by lateral movement of the lower end of the blade.

7. A ball bearing spindle, comprising a base, a blade, a lateral ball bearing between the base and the blade, and a cushioning sleeve having a bearing for the foot of the blade and contained in the base with ability for movement bodily transversely of the base, said base containing a body of damping liquid submerging said sleeve, and the center of lateral bearing pressure between the sleeve and the blade being at such distances from the upper and lower ends of the sleeve that the resistance of said damping liquid to sidewise movement of the sleeve under pressure of the blade tends to incline the sleeve in such measure as to maintain its axis in coincidence with the axis of the blade.

8. A spindle having a base with a depending socket portion closed at its lower end, a cushioning sleeve in said socket portion resting on the bottom thereof and adapted to move laterally in all directions, a blade having a lower bearing in said sleeve and an upper bearing in the base, and locking means engaged with the sleeve and base in a manner to prevent rotation of the sleeve while permitting non-rotative bodily movement of the sleeve.

9. A spindle having a base with a depending socket portion closed at its lower end, a cushioning sleeve in said socket portion resting on the bottom thereof and movable laterally therein, a blade having a lower bearing in said sleeve and an upper bearing in the base, and a device arranged within the sleeve and passing through said sleeve to engage the inner walls of the base, to resist rotation of the sleeve, and with respect to which device, when so engaged, the sleeve is free to move laterally.

10. A spindle having a base with a depending socket portion, a cushioning sleeve contained in said socket portion, a blade having an upper bearing in the socket portion and a lower bearing in said sleeve, the center of lateral pressure of said lower bearing being at a location intermediate the ends of the sleeve such that the sleeve tends to align itself with the blade when moved laterally thereby, and a spring clutch having extremities passing through holes in the opposite sides of the sleeve and pressing against the enveloping walls of the socket, to resist rotation of the sleeve.

11. A spindle comprising a base, a blade contained in said base, a lateral ball bear-

ing between the blade and the base above
the lower end of the blade, a lower bearing
for the foot of the blade, and a cushioning
sleeve holding said lower bearing and lo-
5 cated within said base, said sleeve having
outwardly projecting spring portions ar-
ranged to engage the walls of the base above

and below the step bearing and yieldingly
resist lateral movement of the foot of the
blade. 10

In testimony whereof I have affixed my
signature.

FRED HILDRETH CHAPMAN.