SELF ADJUSTING SPINDLE BEARING

Filed April 15, 1936
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Application April 15, 1936, Serial No. 74,526

1 Claim. (Cl. 308—66)

This invention relates to bearings for spindles which must be run at high speed with the least possible vibration. While capable of general application, our invention is particularly adapted for use in mounting a grinding wheel spindle in a grinding machine.

It is the general object of our invention to provide an improved construction of spindle bearing such that end play as well as transverse vibration of the spindle is substantially eliminated.

A further object is to provide a construction in which this cooperative relation of spindle and bearing will be automatically maintained over a long period of use and wear.

We also provide a construction which is self-adjusting over a substantial range, so that extremely close and accurate fitting of parts is not required. Our invention is thus economical in manufacture and is extremely reliable and effective in use.

Our invention further relates to arrangements and combinations of parts which will be hereinafter described and more particularly pointed out in the appended claim.

A preferred form of the invention is shown in the drawings, in which

Fig. 1 is a front view of our improved spindle and bearing;

Fig. 2 is a sectional front elevation of the same parts, taken along the line 2—2 in Figs. 3 and 10;

Fig. 3 is a plan view, looking in the direction of the arrow 3 in Fig. 1;

Fig. 4 is a plan view of the bearing with the spindle and bearing caps removed;

Fig. 5 is a front elevation of the spindle;

Fig. 6 is a sectional end elevation, taken along the line 6—6 in Fig. 3;

Fig. 7 is a detail plan view with cover plate removed, looking in the direction of the arrow 7 in Fig. 6;

Figs. 8 and 9 are partial sectional views illustrating certain steps in the manufacture of the front bearing bracket and cap;

Fig. 10 is a sectional end elevation, taken along the line 10—10 in Fig. 3;

Fig. 11 is a side elevation of the rear bearing blocks;

Fig. 12 is a partial plan view, looking in the direction of the arrow 12 in Fig. 11;

Fig. 13 is a detail sectional view, taken along the line 13—13 in Fig. 12;

Fig. 14 is a side elevation of the upper front bearing block;

Fig. 15 is a similar view of the lower front bearing block;

Fig. 16 is a detail plan view, looking in the direction of the arrow 16 in Fig. 14;

Fig. 17 is a detail sectional view, taken along the line 17—17 in Fig. 16;

Fig. 18 is a plan view of the lower front bearing block, looking in the direction of the arrow 18 in Fig. 15;

Fig. 19 is a detail front elevation, partly in section, looking in the direction of the arrow 19 in Fig. 6;

Fig. 20 is a partial side elevation of an end disc, looking in the direction of the arrow 20 in Fig. 10, and

Fig. 21 is a detail partial sectional elevation, taken along the line 21—21 in Fig. 20.

Referring to the drawings, our invention comprises a stand 25 adapted to be bolted to a machine frame or other suitable support. The stand 25 is provided with a front bearing bracket 26 (Fig. 4) and a rear bearing bracket 27 and these supporting brackets are provided with bearing caps 28 and 29 secured to the brackets 26 and 27 respectively by clamping screws 30, as shown in Figs. 6 and 10. Front upper and lower bearing blocks 32 (Fig. 14) and 33 (Fig. 15) are mounted on the front bearing bracket 26 and are held from displacement by the front bearing cap 28. Similarly, upper and lower rear bearing blocks 34 and 35 (Fig. 13) are mounted in the rear bearing bracket 27 and are secured from displacement by the rear bearing cap 29.

The front and rear bearing blocks above described support a wheel spindle 40 (Fig. 5) having a straight bearing portion 41, a double conical bearing portion 42 and a counterbalance portion 43. A grinding wheel is shown clamped to one end of the spindle 40 and a driving pulley 44 is shown secured to the other end of the spindle.

We will first describe the rear bearing for the spindle 40. As previously stated, upper and lower rear bearing blocks 35 and 36 (Fig. 11) are provided for the rear straight or cylindrical bearing portion 41. These blocks are provided with an external flange 45 (Fig. 13) having a circumferential groove 47. Otherwise the external surfaces of the bearing blocks 35 and 36 are cylindrical, as indicated at 48 in Fig. 13, and fit closely within an internal cylindrical opening in the assembled rear bearing bracket 27 and cap 29 (Fig. 2). This internal cylindrical surface is grooved as shown at 49 (Fig. 2) to receive the grooved flange 46 on the blocks 35 and 36.
The bearing blocks 35 and 33 are firmly secured in position by a plurality of clamping screws 50 (Fig. 10), and the ends of the rear bearing are closed by end discs 52 (Fig. 2) firmly secured in place by each face of the bearing by cross bolts 53. Each disc 52 is preferably internally grooved as indicated at 54 (Fig. 21) to receive an oil seal washer 55 of felt or other suitable material.

Special provision is made for effective lubrication of the rear bearing. The upper rear bearing block 35 is provided with an oil pocket 97 (Figs. 11 and 13) which, when the parts are assembled, is aligned with an oil hole 56 in the rear bearing cap 25, which hole may be closed to exclude dirt by a screw or plug 69.

The oil pocket 57 has end openings 60 (Fig. 13) communicating with a slot 61 in the internal bearing surface of the block 35. The slot 61 and openings 60 are preferably filled with a wick of felt or some other suitable oil conducting material, which wick directly engages the surface of the straight bearing portion 41 of the spindle 40.

The rear bearing bracket 27 is provided with a segmented oil pocket 65 (Fig. 10) which connects through radial oil openings 66 in the lower bearing block 25 with a transverse slot 68 formed in the internal bearing surface thereof.

The slot 66 and openings 68 are preferably filled with a wick felt or similar material 67 as previously described, and the outer end of the wick 67 extends into the oil pocket 54. The pocket 64 is filled by overflowing the upper oil pocket 57, so that oil will flow around the circumferential groove 47 to the pocket 64. A very small bleed opening 68 in one of the end discs 52 indicates by slight escape of oil therefrom that the lower pocket 64 is amply supplied with oil.

A transverse notch 59 (Fig. 11) is formed in the flange 46 and coacts with a groove 70 (Fig. 10) in the internal surface of the bracket to form an equalizing channel through which oil may flow freely from one side to the other of the bearing block 25.

A removable screw or plug 71 closes a bottom opening 72 through which the oil pocket 54 may be drained when desired.

While the rear spindle bearing as above described is modern or less conventional, except for the described details of construction and lubrication, the front bearing is of a quite special construction which will now be described.

The upper face of the supporting bracket 26 (Figs. 6, 8 and 9) is cut away or recessed at the sides as indicated at 75 to receive downwardly projecting edge portions 76 on the lower face of the cap 28. It will be noted by reference to Figs. 6, 8 and 9 that the projections 76 on the cap are spaced further apart than the recessed portions 15 of the bearing bracket 26.

These parts 26 and 28 are first assembled as indicated in Fig. 8, in which position an internal cylindrical opening 77 is produced by boring or in any other convenient manner.

When the parts are assembled, however, the cap 28 is moved over to the position indicated in Figs. 6 and 9, and is firmly secured in this offset position by the screws 30 previously described.

The lower front bearing block 33 (Fig. 15) is provided with an annular flange 78 having a groove 79 similar to the rear bearing blocks previously described, and the internal surface 77 of the front bearing bracket 26 is similarly grooved as indicated at 80 (Fig. 6) to receive the flange 78.

The lower front bearing block 33 is secured in position by clamping screws 81 and 82 (Fig. 8) and is provided with a segmental V-shaped bearing recess 84 (Fig. 18) having an annular clearance groove 85 at the apex thereof.

The upper front bearing block 32 has a similar segmental V-shaped bearing recess 87 (Fig. 17) and clearance groove 86, but the recess 87 and groove 86 in the upper front bearing block 32 are substantially eccentric to the outer surface of the block 32, which outer surface is of the same width as that of the lower front bearing block 33 and corresponding fits the internal cylindrical opening 77 of the bracket 26.

A stud 90 (Fig. 6) is secured to the upper front bearing block 32 and projects outward into a recess 91 formed in the bearing cap 25. A sleeve 92 is slidable mounted in a transverse cylindrical opening 93 formed in the cap 25 and communicating with the recess 91.

The sleeve 92 is provided with a head 96 and 20 may be secured in axially adjusted position in the opening 93 by a set-screw 95. A coil spring 96 is connected between the stud 90 previously described and an attachment stud 91 mounted in the head 94. A removable cover plate 93 is provided for the recess 91.

The function of the spring 96 is to give the upper front bearing block 32 an impulse to move angularly in a clockwise direction as viewed in Fig. 6, this movement being opposite to the direction of rotation of the spindle 60, which is indicated by the arrow a in Fig. 6.

The upper front bearing block 32 is provided with an oil pocket 100 which receives oil through an oil hole 101 in the cap 25. The block 32 is also provided with slots on the inner inclined bearing surfaces thereof, and wicks of felt or other similar material are placed in these slots as indicated at 102 (Figs. 2 and 6) and extend upward into the oil pocket 100.

A lower oil pocket 104 is formed in the front bearing bracket 26 and receives oil by overflow from the oil pocket 100 as previously described in connection with the rear bearing. The lower front bearing block 33 is similarly slotted to receive a wick felt 105 (Figs. 4 and 6) and the lower part of the wick 106 extends into the oil pocket 104.

End discs 52 are provided, as for the rear bearing, and a bleed opening 107 is provided in one of the discs to show when the pocket 104 is amply provided with oil.

A transverse groove or notch 110 in the circumferential flange of the lower front bearing block 33 and a similar groove or notch 111 in the associated part of the bearing bracket 26 (Fig. 8) coact to equalize the oil distribution at opposite sides of the front bearing, all as previously described.

Having described the details of construction of our improved spindle and bearing, the method of operation and advantages thereof are believed to be readily apparent. The rear bearing which is remote from the wheel W acts as an ordinary cylindrical bearing, and is of reasonably but not excessively close fit.

The front bearing with its V-shaped bearing surfaces obviously positions the spindle axially and entirely prevents end play.

Furthermore, the spring 55 (Fig. 6) tends constantly to rotate the upper front bearing block 32 in a direction to more closely engage the double annular flange of the spindle 48, while the rotation of the spindle in a direction opposite to the pull of the spring 56 prevents the
When in operation, the pull of the spring 96 in one direction and the frictional drag of the spindle in the opposite direction cause the upper front bearing block 32 to assume an adjusted mid-position where these opposing forces are balanced, and in this position the eccentric upper front bearing block effectively prevents transverse vibration of the spindle. When the bearing surfaces begin to wear, the block 32 merely adjusts itself slightly further to the right as viewed in Fig. 6.

Our improved bearing is thus self-adjusting over long periods of use, and requires practically no attention except for oiling. If there is any slight suggestion of transverse vibration, this may be immediately remedied by increasing the tension of the spring 96, which is accomplished by pulling out the tube 32 and securing it in a new adjusted position by the set-screw 95. Similarly, if the bearing tends to heat, the tension of the spring may be slightly relieved by adjustment in the opposite direction.

It will be noted that all parts of our improved bearing are easily constructed and that expert fitting and close adjustment of the bearing parts is reduced to a minimum.

Having thus described our invention and the advantages thereof, we do not wish to be limited to the details herein disclosed, otherwise than as set forth in the claim, but what we claim is:

In a machine tool, a spindle having a normal direction of rotation and a bearing therefor comprising a bearing support and a cap having internal segmental cylindrical surfaces of equal radius, means to secure said support and cap together with the axis of one cylindrical surface offset laterally from the axis of the other cylindrical surface, a fixed bearing member having concentric inner and outer surfaces and secured in said support, a movable bearing member having eccentric inner and outer surfaces and mounted for angular movement in said cap but with the axes of the inner surfaces of said fixed and movable members concentric and with said inner surfaces in direct bearing engagement with said spindle, and a spring to move said movable bearing member in a direction opposite to said normal direction of spindle rotation to an angular position in which the force of said spring is balanced by the frictional drag of the spindle on said movable bearing member.

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