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SPINDLE MOUNTING

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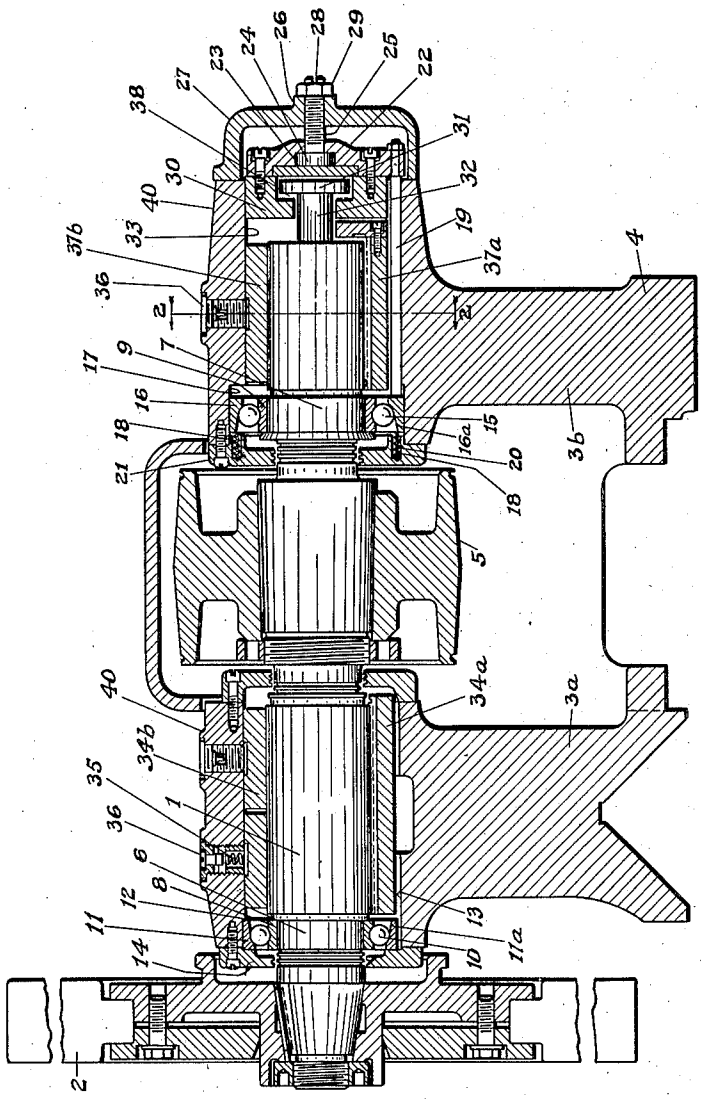



Fig. 1.

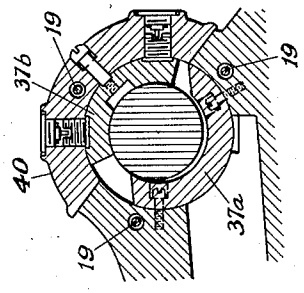



Fig. 2.

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# UNITED STATES PATENT OFFICE.

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## SPINDLE MOUNTING.

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Our invention relates to an improved mounting for spindles or shafts, especially as employed in grinding and other similar machines for rotating a wheel or tool while in engagement with surface of a piece of work.

In grinding and other similar operations, it is of advantage to take a heavy initial cut on the piece of work, and then to reduce the depth of cut as the work is gradually brought to size and finished. Under such conditions of operation, the bearing support for the wheel or tool spindle must be capable of withstanding the lateral strains imposed thereon when taking a heavy cut, without becoming worn to such an extent as to make it impossible for the wheel or tool to make a light cut with the desired accuracy. Ordinary sleeve bearings and also anti-friction roller or ball bearings have both been heretofore separately employed for supporting the wheel spindles of grinding machines and the rotary tool spindles in other similar machines, and while it has been found that ball or roller bearings are better able to withstand severe lateral strains on the spindle than are ordinary sleeve bearings, it has been found also that the small amount of lateral play permitted by rolling bearings, renders it difficult to take the light finishing cuts as accurately as when using sleeve bearings.

By the present invention, we provide an improved mounting for grinding wheel or rotary tool spindles, by means of which it is possible to support such a spindle, as the operator may desire, either in rolling bearings or in sleeve bearings, depending upon the nature of the cut being taken by the wheel or tool. By the use of our improved spindle mounting, it is possible, whenever desired, to change from the support of the spindle with rolling friction, to the support of the spindle with sliding friction, and vice versa, without requiring the removal, or rearrangement of any of the parts of the machine, and without materially affecting the adjustment of the wheel or tool with respect to the work. The above and other advantageous features of our invention will hereinafter more full appear, reference being had to the accompanying drawings, in which—

Fig. 1 is a vertical sectional view of a spindle mounting embodying our invention.

Fig. 2 is a transverse sectional view on the line 2—2 of Fig. 1.

Like reference characters refer to like parts in the different figures.

The drawing shows the invention as applied to a grinding machine spindle 1, the latter providing at one end a grinding wheel 2, and being rotatably supported in suitable arms $3^a$ and $3^b$, provided by the usual wheel head or slide 4 of the machine. A pulley 5 is mounted on the spindle 1 intermediate its ends, whereby the spindle may be driven from a suitable source of power, not shown, and the slide 4 is capable of lateral movement in order to feed the spindle 1 and the wheel 2 toward and from the work.

The spindle 1 is susceptible of finding its support in one or the other of two different sets of bearings, and for purposes of illustration, the parts of our improved mounting are shown in such a position as to support the spindle 1 in the rolling bearings, the change from support of the spindle 1 in the rolling bearings to its support in the sleeve bearings being carried out in a manner which will be hereinafter described.

The spindle 1 at the portions marked 6 and 7 is encircled by inner annular ball races 8 and 9, respectively. A series of balls 10 is circumferentially arranged between the inner race 8 and an outer ball race 11, which is held against a shoulder 12 provided in the cylindrical bore 13 of the arm $3^a$ by means of a clamping plate 14. The interior surface of the outer race 11, from the portion normally in engagement with the balls 10, is of gradually increasing diameter on the innermost side of said balls, as shown at $11^a$, Fig. 1. A second series of balls 15 is arranged between the inner race 9 and an outer ball race 16, which is received in a cylindrical counterbore 17 provided in the arm $3^b$. The inner surface of the outer race 16, from the portion normally in engagement with the balls 15, is of gradually increasing diameter on the innermost side of said balls, as shown at $16^a$, Fig. 1.

In other words, both ball bearings can conveniently be of the well known cup and cone type, since the characteristics of this type lend themselves particularly to the purposes of our invention as will presently appear.

The outer surface of the ball race 16 has a sliding fit within the counterbore 17, and a plurality of springs 18 engage the edge of the race 16 and serve to maintain it in engagement with a plurality of rods 19, 19 projecting into the counterbore 17, said rods being slidable in the arm $3^b$. The springs 18 are received in suitable seats 20 provided in a plate 21 secured to the arm $3^b$. The position of the ball race 16 within the counterbore 17 is thus determined by the amount which the rods 19 extend into the counterbore 17.

The rods 19 are carried by a plate 22 provided with a recess 23, within which is received the head 24 of a bolt 25. The shank of the bolt 25 is in threaded engagement with the central hub 26 of a cap 27 secured to the arm $3^b$, and the end of the bolt 25 is provided with a tool receiving slot 28, whereby the bolt 25 may be turned to cause movement of the plate 22 with respect to the cap 27. A nut 29 is provided to lock the bolt 25 against turning movement, after the desired adjustment of the plate 22 has taken place.

The plate 22 is connected to a yoke member 30, which embraces a head 31 provided on a reduced portion 32 of the spindle 1. The yoke 30 is annular in form and its outer periphery fits closely within the main bore 33 of the arm $3^b$. Movement of the plate 22 and the yoke 30 by means of the bolt 25, is adapted to cause longitudinal movement of the spindle 1 when it is desired to change from support of the spindle 1 by ball bearings to support of the spindle by sleeve bearings, or vice versa, as will now be described.

A sleeve bearing is received within the bore 13 of the arm $3^a$, and as best shown in Fig. 2, is made in two parts, $34^a$ and $34^b$. The parts are so proportioned that the weight of the spindle 1 is taken off the lower bearing portion $34^a$, when the spindle 1 is supported by the ball bearings, as shown in Fig. 1. Springs 35 exert their pressure to maintain the bearing portion $34^b$ in engagement with the spindle 1, said springs being seated in adjustable members 36 threaded within openings provided in the bearing caps 40, 40. Lower and upper bearing portions $37^a$ and $37^b$ are received within the bore 33, in precisely the same manner as the bearing portions $34^a$ and $34^b$ of bore 13.

When the spindle is driven with the parts in the positions shown in Fig. 1, the balls 10 and 15 take the entire load, and this is the preferable mode of operation when the grinding wheel 2 is taking a heavy cut. When it is desired to take a light or finishing cut with the wheel 2, the support of the spindle is shifted from the ball bearings to the sleeve bearings by turning the bolt 25 so as to cause the plate 22 and the yoke 30 to be drawn to the right. It will be noted that with the parts in the position shown in Fig. 1, there is a clearance space 38 between the yoke 30 and the head 31 on the spindle 1, so that the plate 22 will first be moved without moving the spindle 1 with it. As the plate 22 is drawn to the right, the rods 19 move with it, thus allowing the springs 18 to shift the outer ball race 16 to the right, and bringing the portion $16^a$ opposite the balls 15; this transfers the load onto the oil film of the sleeve bearing portion $37^a$.

Continued turning of the bolt 25 causes the yoke 30 to engage the head 31 of the spindle 1 and thus draws the spindle 1 longitudinally to the right. When this occurs the inner ball race 8 moves with the spindle 1, thus bringing the balls 10 opposite the outer race portion $11^a$, and rendering said outer race ineffective; this completes the transfer of the load onto the oil film of the sleeve bearings, which is the preferable mode of operation for the wheel 2 to take a light cut with extreme accuracy, since the sleeve bearings steady the spindle, and prevent it from chattering. As will be apparent, an opposite movement of the bolt 25, to shift the parts to the left, restores the ball bearing support and relieves the load from the sleeve bearings. It will be understood of course that in shifting from either mode of support to the other, the members 36, 36 are subject to adjustment, to hold the portions $34^b$ and $37^b$ to their work, or to free the spindle from the pressure of said members, as may be required.

From the foregoing, it is apparent that by our invention we have provided an improved mounting for rotating spindles, whereby the spindle can, at will, be supported in the most advantageous manner, to fulfill the requirements of either a heavy cut or a light cut of the grinding wheel. While we have shown our invention as embodied in a particular arrangement of the parts of a grinding machine, it is obvious that it is not so limited in its application, but can equally well be employed in connection with the support of a spindle carrying any kind of rotating tool.

We claim,

1. In a device of the class described, a spindle, a ball bearing associated therewith, a sleeve bearing, independent of said ball bearing or the races thereof, also associated with said spindle, and means for interchangeably rendering one or the other of said bearings operative, while maintaining the same assembly of parts.

2. In a device of the class described, a tool carrying spindle, a series of circumferentially arranged bearing members for rotatably supporting said spindle with rolling friction, a cylindrical bearing member for rotatably supporting said spindle with sliding friction, and selective means for shifting said spindle axially to transfer its support interchangeably from one type of bearing member to the other.

3. In a device of the class described, a tool carrying spindle, a series of circumferentially arranged bearing members for rotatably supporting said spindle with rolling friction, a cylindrical bearing member for rotatably supporting said spindle with sliding friction, and manually operated means for shifting said spindle axially to transfer its support interchangeably from the rolling bearing members to the cylindrical bearing members.

4. In a device of the class described, a tool carrying spindle, a series of circumferentially arranged bearing members for rotatably supporting said spindle with rolling friction, a cylindrical bearing member for rotatably supporting said spindle with sliding friction, and manually operated means for shifting the axis of rotation of said spindle to transfer its support interchangeably from one type of bearing member to the other.

5. In a device of the class described, a supporting member having a cylindrical bore extending therethrough, a tool carrying spindle received in said bore, a series of circumferentially arranged bearing members for rotatably supporting said spindle within said bore, a cylindrical bearing member for rotatably supporting said spindle, and manually operated means for causing relative movement in the direction of the spindle axis between said circumferential bearing members and said spindle, to interchangeably shift the support of the said spindle from one type of bearing member to the other.

6. The combination with a rotary spindle, of ball bearing supports and sleeve bearing supports independent of said ball bearing supports therefor, and means for selectively and interchangeably rendering operative one or the other of said supports.

7. The combination with a rotary spindle adapted for support in cup and cone ball bearings, of sleeve bearings independent of said cup and cone for said spindle, and means for rendering the latter operative or inoperative by relative movement between the parts of said ball bearings.

8. In a device of the class described, a supporting member having a cylindrical bore extending therethrough, a tool carrying spindle received in said bore, a series of circumferentially arranged bearing members for rotatably supporting said spindle by rolling friction within said bore, races for said circumferentially arranged bearing members, a bottom bearing segment for said spindle entirely independent of said races and rigidly held within said bore, and means for displacing said circumferentially arranged bearing members so as to allow said spindle to rest on said bottom bearing segment.

9. In a device of the class described, a supporting member having a cylindrical bore extending therethrough, a tool carrying spindle received in said bore, a series of circumferentially arranged bearing members for rotatably supporting said spindle by rolling friction within said bore, races for said circumferentially arranged bearing members, a bottom bearing segment for said spindle entirely independent of said races and rigidly held within said bore, means for displacing said circumferentially arranged bearing members so as to allow said spindle to rest on said bottom bearing segment, and a top segment adapted thereupon to automatically descend upon said spindle.

10. In a device of the class described, a supporting member having a cylindrical bore extending therethrough, a tool carrying spindle received in said bore, a series of circumferentially arranged balls for rotatably supporting said spindle by rolling friction within said bore, races for said circumferentially arranged bearing balls, a bottom bearing segment for said spindle entirely independent of said races and rigidly held within said bore, and means for displacing said balls so as to allow said spindle to rest on said bottom bearing segment.

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