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BEARING FOR GRINDING SPINDLES

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2 Sheets-Sheet 1

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To whom it may concern.

Be it known that I, Ralph L. Morgan, a citizen of the United States, residing at Worcester, in the county of Worcester and State of Massachusetts, have invented new and useful Bearings for Grinding Spindles, of which the following is a specification.

This invention relates to an internal grinding machine of the type in which a grinding wheel is used for grinding an interior cylindrical or conical surface. The grinding wheel should have considerable overhang so that it may be employed for grinding surfaces of as long a length as may be desired.

In the type of machine to which the invention is particularly adapted, the power is received at the opposite end of the spindle by a belt or the like. The grinding wheel spindle itself is supported in a stationary sleeve carried by the frame of the machine and located of course between the work and the pulley or the like on the end of the spindle for receiving the power. Heretofore, it has been customary either to arrange the parts so that the side thrust at both ends of the grinding wheel spindle would be in the same direction or to provide the parts in such relation to each other that the side thrust would be in opposite directions at opposite ends. In the first case there is obviously a tendency to distort the spindle so that it will run out of true at the center and necessarily also the wheel will run out of true beyond its bearing. In the latter case there is also a tendency to distort the spindle by the thrust at one end in one direction, and in the other direction by the thrust at the other end. These forces do not exactly neutralize each other in practice so that this also is an imperfect arrangement and it is necessary to provide a firm bearing on one side of the spindle at one end and on the other side at the other. It is also necessary to back the spindle up by bearings near the opposite respective sides of said firm bearings and make them capable of giving slightly, and it is also necessary to conduct lubricant constantly to each of said bearings.

The principal object of this invention is to provide means whereby the latter type of grinding can be done, that is with the thrust in opposite directions at the opposite ends of the grinding wheel spindle, and to provide the bearings at the opposite ends of the shaft in such form that there will be no bearing deflection or tendency for the spindle to hunt for its bearing seat and yet a solid bearing can be secured on opposite sides of the spindle at the two ends and a yielding bearing opposite each of them and at the same time all of these bearings can be constantly lubricated in a most effective manner.

Additional objects and advantages of the invention will appear hereinafter.

Reference is to be had to the accompanying drawings in which

Fig. 1 is a central sectional view of a part of a grinding machine through the center of the spindle showing a preferred embodiment of this invention;

Fig. 2 is a perspective view of one of the solid bearings;

Fig. 3 is a perspective view of one of the yielding bearings;

Fig. 4 is a perspective view of the means for lubricating the two bearings of the pair; and

Fig. 5 is a diagram showing the action.

In this case the grinding wheel spindle 10 is mounted in a housing 11 which is fixed in the frame 12 of the grinding machine. The details of this housing and its connected parts need not be described as it can be made in the ordinary manner, except as to the points referred to hereinafter. It is made hollow with a space larger than the spindle to contain lubricating oil.

This spindle is intended to bear at the ends of the housing, one bearing being located within the body of the frame preferably and the other necessarily projecting beyond it in a small cylindrical projection 13 through which the spindle 10 projects and at the end of which is located the grinding wheel 14. This is necessary in order that the work W may be moved back and forth throughout considerable traverse while it is also rotating. It is intended, that when grinding the rear internal surface of the work, the work shall rotate in one direction, and that the spindle 10 shall rotate in the opposite direction.

On the other end of the spindle I have shown a pulley 15 receiving power from a belt 16 which is shown as extending in such a direction that the belt thrust at that end is
is in one direction while the thrust on the other end is in the opposite direction.

For supporting the ends of the spindle in the housing 11 I have provided at each end a solid segmental bearing 20. These two bearings are located on opposite sides of the spindle and each on the side of the spindle toward which the thrust at that point takes place while the machine is operating.

These are lined with bearing metal and fixed in position so that they cannot move in any direction. Preferably they are half bearings. Opposite each of these half bearings is a small segmental bearing 21 which is not intended to be absolutely fixed in position but is provided with two recesses 22 into which project springs 23 set in the sleeve 11 and of such size and strength as to force the bearing into intimate contact with the spindle at all times. These segmental bearings are lined with bearing metal and each one is shown shorter than the opposite bearing 20 as well as being spaced from its edges on both sides.

Surrounding each of the segmental bearings 21 is a sheet 24 of fibrous absorbent material preferably felt. This preferably is made in a single piece and has a perforation 25 of approximately the same size and shape as the segmental bearing piece 21 to receive it. This piece of felt performs the function of conducting liquid lubricant from the enlarged space in the housing 11 in which the lubricant is held. As it entirely surrounds the bearing piece 21 it is obvious that the surfaces all around it will be thoroughly lubricated and as it extends the whole length of the half bearing 20 on both sides, it constantly lubricates its surfaces.

In fact, it contacts with the spindle throughout its length along the two edges of the half bearing 20. It also is held in position by the segmental bearing member 21 which cannot get out of its position on account of the springs 23.

Although I have not referred in detail to both of the bearings, it is to be understood that those at the two ends of the spindle are constructed in the same way although their sizes may be different. In each case the spindle bears against the half solid bearing 20 seated in the housing for receiving the direct thrust. This bearing is long enough so that the thrust cannot materially bend the spindle and yet leaves enough space for oil between the two boxes. On the opposite side in each case the metallic bearing block 21 is located and pressed up firmly against the spindle by the springs half way between the ends of the corresponding solid bearing. When first put in, this bears solidly against the opposite face of the interior of the sleeve but it moves up to take up wear by the action of the springs behind it.

The standard practice in the art of internal grinding is to support the spindle by two bearings located of course between the belt pulley on one end of the spindle and the grinding wheel on the other. The work is ground on the side toward the front of the machine, that is, toward the operator. The pull of the belt naturally is toward the rear of the machine and the direction of thrust on the two ends of the spindle is the same, that is, toward the rear. This forces the spindle up against the rear sides of the two bearings while the work is being performed and the re-action against the spindle by these bearings is in the opposite direction, that is forward. Now the bearing toward the pulley acts as a fulcrum when the work is removed from the abrasive wheel and the spindle is forced toward the front at the other end and rests against the front bearing. But when the work is brought into position and the cutting starts, the cutting re-action of the abrasive wheel throws the spindle away from this front surface and it takes its seat on the rear surface of the bearing next to the wheel. Therefore the spindle can flutter from one side of this bearing to the other.

When the work has been removed from the wheel the spindle, on account of the belt pull on the opposite end, jumps to the forward side of the bearing and takes this bearing at that point. It must be kept in mind that all solid bearings have some clearance to provide oil space and this is sufficient to cause a noticeable flutter of the spindle under the conditions above mentioned. There is a tendency when the work is withdrawn for the wheel to move off the edge and grind a slight conical surface instead of keeping it square.

I overcome this difficulty in accordance with my invention in the manner shown in the diagram Fig. 5. Here the belt pull C re-acts into B. With B as a fulcrum the 110 spindle gets its bearing at D and is also always held against D by the belt pull C acting over B as a fulcrum.

The grinding re-action of the abrasive wheel while cutting at E gives a thrust in the direction of the arrow F. Therefore with the thrust F acting through or on D as a fulcrum the spindle is always held against its seat at B. In other words the belt re-action at C has exactly the same action towards keeping the spindle in its bearings as the grinding re-action at E which sets up the thrust F. In this case there is no tendency for the spindle to jump from one side to the other or flutter. Even if the work be withdrawn from the abrasive wheel the spindle will still remain in its seats at B and D.

It has also been proposed to grind at the front as I do with the belt pull toward the
rear and attempt to overcome this flutter by providing opposite bearings, that is, two half bearings on the spindle at their extreme ends, one near the pulley and the other near the wheel, and two half bearings located diametrically opposite the other two inwardly toward the center. The bearings themselves thus have a re-action which tend to bend the shaft inwardly in the middle away from the two half bearings that are closest together. This throws the pulley and the grinding wheel toward this side on which these latter two half bearings are located.

But the belt re-action and the grinding re-action tend to produce the opposite effect, forcing the wheel and pulley in the opposite direction to that just described and tending to deflect the shaft at its middle point toward the front of the machine. Therefore one force acts against the other. This causes the spindle to be deflected both at the center and at the ends in different amounts according to the amount of power applied by the belt and the depth of cut taken by the abrasive wheel. This necessarily causes a flutter of the spindle and grinding wheel.

In describing the difficulties of previous constructions it is to be understood that this flutter is only of a small amount, limited by the oil space in the bearings, but the grinding art has been developed to such a high degree that at the present time this small deflection presents serious difficulty and prevents the performing of the highest class of work. My invention is designed to overcome it.

In this way there is no necessity of offsetting the yielding bearing from the solid one and no chance of these two bearings touching one another or their being lubricated to a different degree or one of them getting an undue share of oil. The possibility of making these bearings longer than is the case where two bearing blocks are offset from each other is an important matter because of its preventing the vibration of the shaft at the center between the two boxes and the overhung wheel.

The reduction of this vibration by a small amount, as for example one or two tenths thousandths of an inch, is a matter of material importance in the art of grinding and it is accomplished by this construction.

Although I have illustrated and described only a single form of the invention and shown it as applied only to a particular type of grinding machine I am aware of the fact that modifications can be made therein by any person skilled in the art and that it can be applied to other machines and other types of grinding machines without departing from the scope of the invention as expressed in the claims. Therefore I do not wish to be limited to all the details of construction herein shown and described but what I do claim is:

1. In a grinding machine, the combination with a grinding wheel spindle and a housing in which it is journaled, of segmental bearings located near the ends in the housing, segmental bearings arranged centrally in alignment with the main bearings and capable of yielding, and means for conducting a lubricant to the surfaces of the shaft at all points co-extensive with said bearings.

2. In a grinding machine, the combination with a housing having a passage therethrough, of a grinding wheel spindle extending through said passage longitudinally, a grinding wheel on the spindle at one end, a pulley on the other end of the spindle, a belt on the pulley exerting a thrust thereon in one direction, and means for supporting an article to be ground in contact with the grinding wheel on the side thereof toward which the thrust is exerted by the belt, a pair of bearings solidly mounted within the housing, one at the grinding wheel end of the spindle opposite the point at which the work engages the wheel and the other on the other side of said spindle at the end near the pulley, and a pair of segmental bearings located at the ends of the spindle directly opposite the respective solid bearings.

3. In an internal grinding machine, the combination with a housing having a passage therethrough, of a grinding wheel spindle extending through said passage longitudinally and smaller than the passage, a grinding wheel on the spindle at one end, a pulley on the other end of the spindle, a belt on the pulley exerting a thrust thereon in one direction, and means for supporting an article to be ground in contact with the grinding wheel on the side thereof toward which the thrust is exerted by the belt, a pair of solid half bearings fixedly mounted within the housing, one at the grinding wheel end of the spindle opposite the point at which the work engages the wheel and the other on the other side of said spindle at the end near the pulley, and a pair of segmental bearings each entirely out of contact with the respective half bearing and located at the ends of the spindle directly opposite the respective half bearings.

4. The combination with a stationary housing, a spindle extending therethrough and having a tool on one end beyond the housing, and means on the other end of the spindle for driving it, of a bearing for the spindle in the housing comprising a half bearing in fixed position against the housing, a segmental bearing located exactly opposite the half bearing and yieldingly pressed toward it and of less length and width than the half bearing, and absorbent material for conducting lubricant to the surfaces of the spindle surrounding the seg-
mental bearing and in contact with its edges and also with the edges of the half bearing.

5. The combination with a spindle having a metal working device on the end thereof, of a solid bearing member thereof on one side of the spindle, a bearing member in contact with the other side of the spindle, said bearing members together having a combined width less than the circumference of the spindle and spaced from each other along the spindle at both sides, one of said bearing members being shorter than the other, absorbent material located in the spaces between the two bearing members along the sides thereof and also located in the spaces beyond the ends of the shorter bearing member so that the two bearing members and the absorbent material together constitute a complete cylinder surrounding the spindle, and means for yieldingly forcing one of said bearing members toward the other.

6. In a bearing, the combination of a half bearing member and a piece of absorbent felt located opposite it and in contact with its edges and having an outside area equal to that of the half bearing member so that together they constitute a complete cylinder for surrounding the spindle to be supported thereby, said piece of felt having an opening and fitting it in a position opposite the half bearing member, one of said bearing members being yieldingly mounted.

In testimony whereof I have hereunto affixed my signature.

RALPH L. MORGAN.