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3,045,399

METHOD FOR HONING BEARING SURFACES

Filed May 18, 1959

2 Sheets-Sheet 1

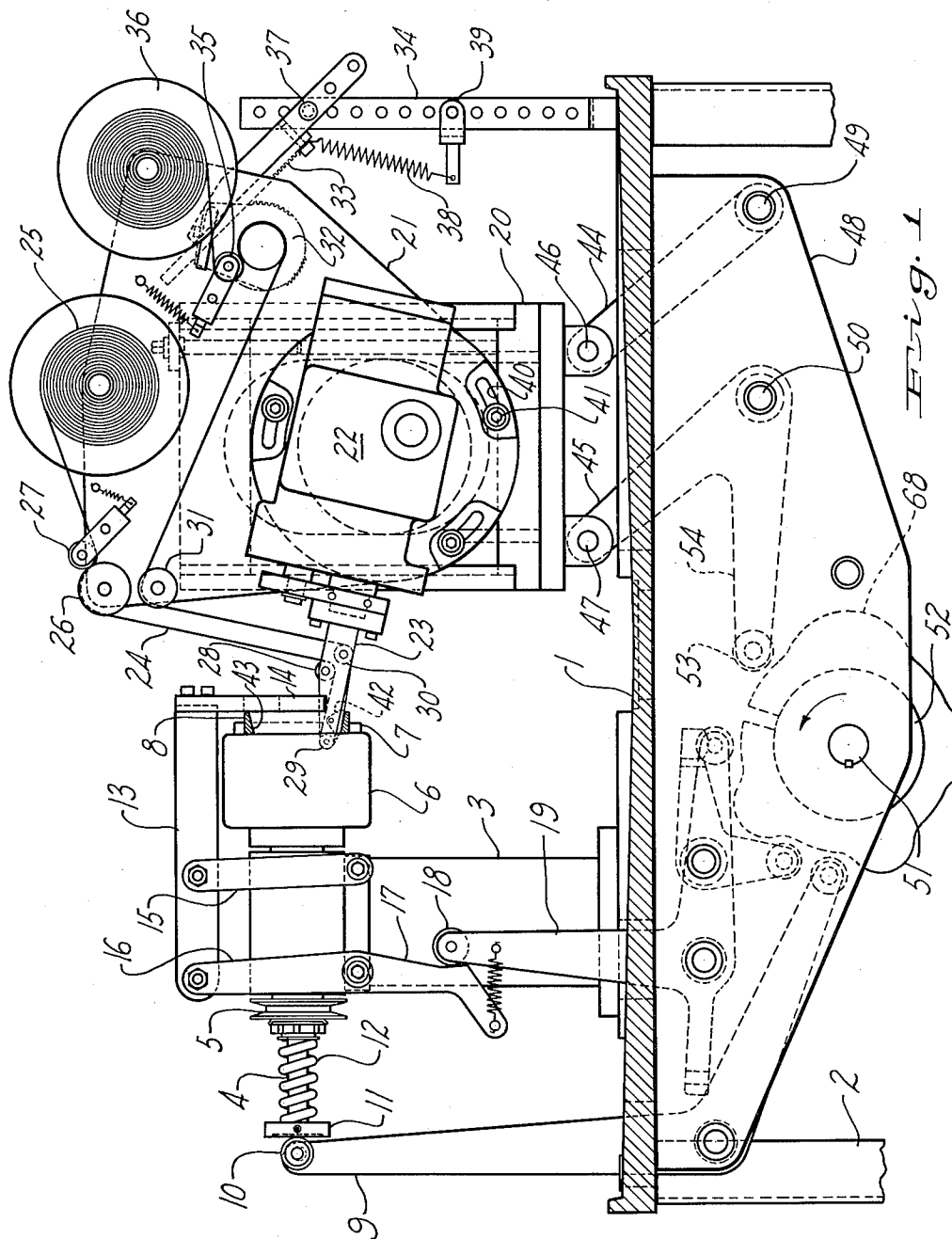


Fig. 1

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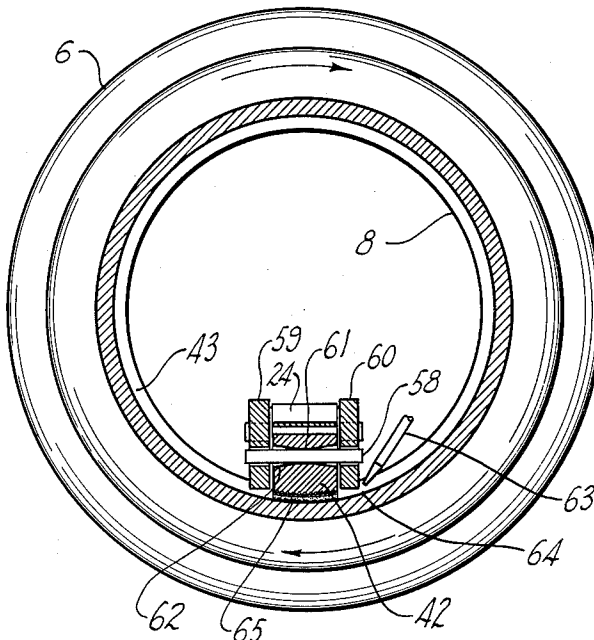


Fig. 2

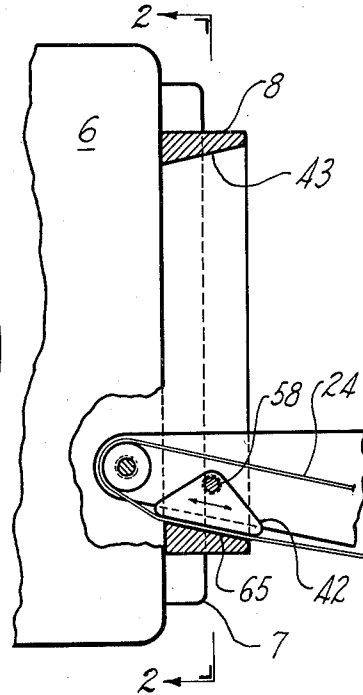


Fig. 3

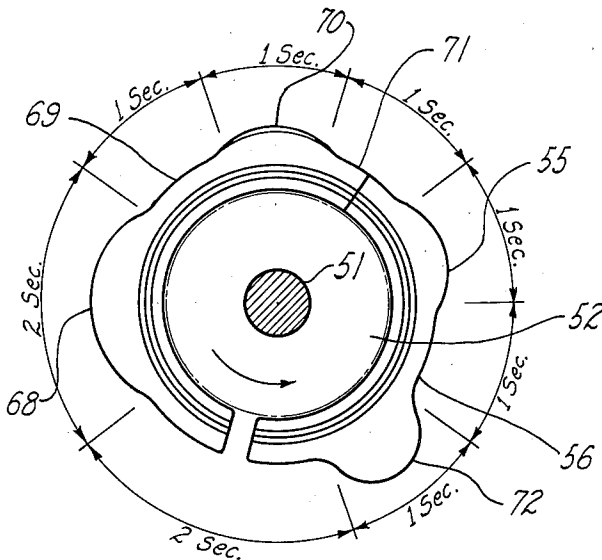


Fig. 4

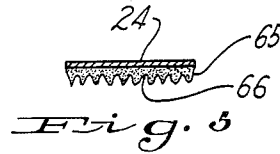


Fig. 5

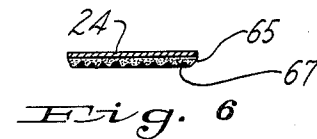


Fig. 6

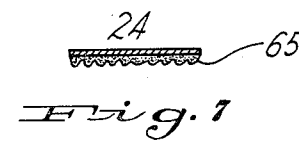


Fig. 7

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METHOD FOR HONING BEARING SURFACES
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3 Claims. (Cl. 51—291)

This invention relates to method of and apparatus for super-finishing roller bearings or other metal objects having ground surfaces by removing the surface defects produced by grinding.

Ground surfaces have a layer of smear and certain pitch defects or grinding ridges, chatter marks, grinder flats and other waviness. By honing these ground surfaces, they become smooth and the surface defects generally disappear.

In my co-pending application serially numbered 759,798 filed September 8, 1958, issued as Patent No. 2,938,308, dated May 31, 1960, of which the present application is a continuation-in-part, I have shown and described apparatus employing endless strips of abrasive material for honing.

When using strip abrasive material that comes in roll form it is fed in increments to expose a new surface of abrasive material for each surface to be honed, the abrasive surface of the strip being applied to make reciprocatory sliding pressure contact with the grounded surface transversely of the direction of travel of said surface which is at a linear speed of approximately 7200 feet per second.

I have found that when the grit of the abrasive strip acts upon the surface being honed, the abraded metal is removed in the form of tiny chips (when viewed under a microscope). These chips accumulate in the interstices of the abrasive surface which clogs it and as the chips build up between the abrasive grit, the grit itself wears off to the level of the clogged material and becomes a part of the clogging substance, thus reducing or entirely preventing further honing action. All this takes a matter of seconds as the usual honing cycle on the average roller bearing cup of about a four-inch diameter with a one-inch face, for example, is completed within ten seconds or less.

To obtain the desired super-finish or polished surface, it is desirable to utilize the partly worn grit surface for the final honing step instead of replacing it with a new sharp grit surface. The problem therefore, is to remove the clogged materials from the grit surface which cannot be done by merely running a flushing liquid such as water, oil or solvent on the honed surface because the clogged material obstructs the flow of the liquid into the grit surface. Also, the use of a liquid as a coolant or as a cutting or polishing compound does not prevent the clogging action of the metal chips and the worn off grit.

I have discovered that by supplying a flushing liquid to the moving surface being honed on the side it enters the abrasive material, the liquid will, by contact with the moving surface, be subjected to considerable force and by momentarily breaking contact of the abrasive material with the surface being honed, the liquid will flush out the clogged metal and grit. To be most effective, contact between the abrasive surface and the honed surface may be broken one or more times during the honing cycle which may be ten seconds or less so that if contact

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is broken four times for flushing, the actual time of contact of the abrasive with said surface may be only four seconds out of the ten second cycle. At the time of the final contact of the grit with the partially honed surface, the grit will have its sharp points worn sufficiently to produce a super-finish.

The invention will become more apparent from a consideration of the accompanying drawings constituting a part hereof in which like reference characters designate like parts and in which:

FIGURE 1 is a front elevational view, partially in section, of a tape honing machine;

FIGURE 2, an end elevational view of a bearing cup mounted in a chuck with the honing shoe and abrasive material making contact with the bearing surface, the view of FIGURE 2 being taken along the line 2—2 of FIGURE 3;

FIGURE 3, an enlarged detail of the end of the chuck in which a bearing cup is mounted and of the shuttle arm carrying the honing shoe shown in FIGURE 1;

FIGURE 4 is a diagrammatic illustration of a cam for actuating the support on which the shuttle head is mounted to break contact of the abrasive with the bearing surface;

FIGURE 5 is an enlarged cross-section of the honing tape with abrasive surface;

FIGURE 6, a similar view showing the clogged areas between the grit or abrasive particles; and,

FIGURE 7, a similar view of the partly worn grit with the clogged material flushed out.

The description and illustration of the invention as applied to the honing of roller bearings is for demonstration only, as it is obvious that it has application to the honing of any metal surface.

With reference to FIGURE 1 of the drawing, the numeral 1 designates a base supported on uprights 2, the base supporting a pillow block bearing 3 in which is journaled a shaft 4 rotated by a motor (not shown) having a belt connection with a sheave wheel 5, one end of the spindle being provided with a chucking mechanism 6 having gripping jaws 7 that hold the cup 8 of a roller bearing which is shown in the enlarged view of FIGURES 2 and 3. The chucking mechanism is actuated by a cam lever 9 having a follower 10 engaging a disc 11 to subject the shaft 4 to axial movement, a coil spring 12 being provided to normally bias the chucking jaws 7 to their closed position.

A paddle mechanism consisting of an arm 13 with a paddle 14 is mounted on the pillow block bearing 3 and is provided with a pair of parallel links 15 and 16, the latter having an extension 17 that is engaged by the follower 18 of a cam lever 19, all as described in the aforementioned co-pending application and is no part of the present invention. The function of the paddle 14 is to yieldingly engage the bearing cup 8 and move it into the chuck jaws 7.

The honing mechanism is generally like that disclosed in my aforementioned co-pending application in that it consists of a frame 20 on which is mounted a plate 21 and a shuttle head generally designated by the numeral 22, the shuttle arm 23 being mounted in the head 22 for oscillatory movement in a direction axially of the arm which is from left to right as viewed from the base of FIGURE 1 of the drawing. The abrasive tape 24 is supplied from rolls 25 and is passed around guide rollers

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26, tension roller 27, guide rolls 28, 29, 30 and 31 and thence passes to a feed mechanism generally designated by the numeral 32 that is actuated by a gear rack 33 which is adjustably mounted on an upright 34 to vary the thrust resulting from the tooth engagement of the rack 33 with the gear wheel 32 of the ratchet feed mechanism. A tension roll 35 also functions as a guide roll to guide the used tape on a gathering reel 36, all as described in the aforementioned co-pending application and constitutes no part of the present invention. Tension on the rack 33, which is adjustably mounted by a pin 37, may be independently supplied and regulated by the spring 38 and the bracket 39 which is adjustably mounted on the upright 34, as shown.

The shuttle head 22 is angularly adjustable in the frame 20 by the segment slots 40 engaged by bolts 41 to vary the inclined position of the honing shoe 42 relative to the bearing surface 43 of the bearing cup 8. The frame 20 is mounted on a link 44 and a bell crank lever 45 to which it is pivotally connected at 46 and 47, respectively. The link 44 and bell crank lever 45 are pivotally mounted to an apron 48 extending below the machine base 1, as shown at 49 and 50. A cam shaft 51 is mounted with a cam generally designated by the numeral 52 in alignment with a follower 53 mounted on the arm 54 of the bell crank 45. The cam 52 is more clearly shown in FIGURE 4 of the drawing as a plurality of rises 55 and dwells 56 which subject the frame 20 and the honing head in its entirety to oscillatory movement to intermittently make and break contact of the honing shoe 42 and tape 24 with the bearing surface 43 of the bearing cup 8.

The oscillatory movement of the shuttle head frame 20 and plate 21 effects engagement of the tape feeding mechanism 32 with the gear rack 33 to feed the tape forward to renew the abrasive surface under the honing shoe once for each revolution of cam 52.

The honing shoe 42, which is more clearly shown in FIGURE 2 of the drawing, is mounted by a pin 58 on the shuttle arms 59 and 60. The honing shoe 42 is provided with a bore 61 having flared ends 62 which allows for self alignment of the shoe 42 with the bearing surface 43. At the same time, the honing shoe is free to pivot around pin 58 to align the abrasive cutting surface of the honing tape 24 with the inclination of the bearing surface 43. A nozzle 63 is disposed inside of the cup 8 to supply a liquid designated by the numeral 64 to the bearing surface 43 of the bearing cup 8 at the point it passes underneath the grit designated by the numeral 65, thus submerging the housing tape in the fluid.

It is generally known that oil used on a grit stone will reduce, if not entirely destroy, the cutting action of the grit and kerosene or carbon oil is a fluid which will clean out a grit surface after it has been used. I prefer to use kerosene or a solvent with a small percentage of oil as the flushing or cleansing fluid. It is to be understood that this fluid has no effect on the cutting action of the abrasive and may not affect the finish or polish of the honed surface. It is merely used in the instant case as a flushing agent and functions in the following manner:

In FIGURE 5, the honing tape 24 is shown as having a surface of abrasive material 65 which, in the enlarged view of FIGURE 5, is shown as having sharp points. When this abrasive surface contacts the ground surface 43 of the bearing cup 8, it will remove fine chip-like metal particles that accumulate in the interstices 66 of the abrasive surface 65 to clog it, as shown by the dark areas 67 in FIGURE 6 of the drawing. By intermittently raising the abrasive surface 65 from the bearing surface 43, the fluid 64 from nozzle 63 will pass between the grit and bearing surfaces 65 and 43, respectively, with sufficient force to cause the clogged cuttings 67 to be flushed out of the grit, leaving a clean grit surface, as shown in FIGURE 7 of the drawing. It will be noted that the

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sharp tips of the grit 65 are worn smooth in the view of FIGURE 7 and this smoothness aids in obtaining the final smoothness or super-finish on the honed surface.

The making and breaking of contact of the abrasive material with the bearing surface will now be described with reference to FIGURE 4 of the drawings. Assuming the rise 68 of cam 52 to be in contact with the cam follower 53 when the bearing cup 8 has been chucked and is ready for the honing operation, rotation of the cam in a counter-clockwise direction will cause the follower to drop into the dwell 69 causing the shuttle head to move forward and allowing the honing shoe 42 with its honing tape 24 to make contact and seat on the bearing surface 43 of the bearing cup 8. At this instance, the bearing surface of cup 8 is rotating at a peripheral speed of approximately 7200 inches per minute and the shuttle arm 58 may be oscillating at approximately 1800 times per minute. The honing action of the abrasive surface 65 on the bearing surface 43 will then be effective for a period of one second, as indicated in FIGURE 4 of the drawing. When the follower 53 hits the next rise 70, the honing shoe and abrasive surface break contact with the bearing surface 43 and the flushing fluid 64 will flush out the clogged material 67 from the grit surface 65. The follower then again passes into the dwell designated by the numeral 71 to effect contact and to hone the surface 43 and will subsequently again break and make contact then the follower 53 passes over the rise 55 into the dwell 56 and finally on the rise 72 and then in the dwell 73 at which time the honing cycle is completed. By the time the abrasive surface 65 of the tape 24 makes its final or fourth contact with the surface 43, the tips have been worn smooth, as shown in FIGURE 7, and a super-finish surface is produced with all the pitch defects removed.

The rise 68 of cam 52 is sufficient to rock the frame 20 and plate 21 to actuate the tape feed mechanism 32 by engagement with rack 33. The rises 70, 55 and 72 are of a magnitude to break contact of the abrasive with surface 43 without, however, causing sufficient movement of the feed mechanism to advance the honing tape.

The super-finished bearing surface resulting from the present process of honing eliminates the howling sound from such bearings when operating at the great speeds at which such bearings are used in modern industry. The finished bearings are not tested until after they have been completed and assembled and if they produce a howling sound at high speeds, they are a total loss, as it would be too costly to dismember the assembled parts.

Although one embodiment of the invention has been herein illustrated and described, it will be evident to those skilled in the art that various modifications may be made in the details of construction without departing from the principles herein set forth.

I claim:

1. In the method of honing a previously ground metal surface moving at relatively high linear speed by applying an abrasive material submerged in a flushing fluid to said moving surface while subjected to reciprocatory movement transversely of the direction of travel of said surface, the step of lifting said abrasive material away from said moving surface to cause the fluid to flush out the accumulation of cuttings from the working surface of said abrasive material.

2. In the method of honing bearings by applying an abrasive material submerged in a flushing fluid under pressure to the bearing surface while the latter is rotating at relatively high peripheral speed and while subjecting said abrasive material to reciprocatory movement transversely of the direction of rotation of the bearing surface, the step of intermittently lifting said abrasive material away from the bearing surface to cause the fluid to flush out the accumulation of cuttings from the honing surface of said abrasive material.

3. In the method of honing bearings by applying the abrasive material on one side of a honing tape submerged in a flushing fluid to the bearing surface rotating at relatively high speed while subjecting it to reciprocatory movement transversely of the direction of rotation of the bearing surface, the step of intermittently lifting said abrasive material away from the bearing surface to cause the fluid to flush out the accumulation of cuttings from the honing surface of said abrasive material.

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