METHOD AND DEVICE FOR THE HONING OF CONICAL BORES

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Filed Jan. 15, 1968, Ser. No. 697,920
Int. Cl. B24b 9/02
U.S. Cl. 51—353

11 Claims

ABSTRACT OF THE DISCLOSURE

Method and means for honing conical bores wherein the workpiece is rotated and the honing tool includes honing stones which are initially retracted and subsequently expanded within the conical bore to adapt themselves to the configuration of the bore. The honing tool includes an outer body with a rotatable central spindle. One end of the spindle carries expanding means, preferably in the form of longitudinally extending, eccentrically arranged pins which operatively engage honing stone holders resiliently carried in guide slots in the outer body. By a relative movement of the outer body and the spindle the expanding means can be moved between a first position wherein the honing stone holders are retracted and a second position wherein the honing stone holders are expanded relative to the central axis of the outer body. A clamping nut is rotatably carried on the outer body and carries one end of a torsion spring which surrounds the outer body. The other end of the torsion spring engages over a securing pin fixed to the spindle and extending through a transverse slot in the outer body. A set screw is also carried by the clamping nut for securing the same in a selected adjusted position to the outer body. The outer body and the spindle are tensioned for relative rotation by the torsion spring and engagement of the securing pin against the extremities of the transverse slot limits the relative rotation between the spindle and the outer body.

The invention relates to a method and a device for the honing of conical bores. While it has been known to hone cylindrical bores by securing the honing tool in articulated fashion i.e. only guided in the workpiece, carrying out a rotating and at the same time an axial reciprocating movement with the introduction of fluid, conical bores have been finished heretofore by turning, reaming or grinding and not by honing.

The instant invention has as its primary object the provision of methods and means which permit the use of honing to improve bores which have been machined to a conical shape from both the standpoint of geometric form and surface quality. According to the basic objects hereof, relative rotation is provided between honing stone holders and an expanding means whereby the honing stones may be moved from a retracted position to an expanded position, the honing stones in the expanded position being resiliently urged against a conical bore in a relative movement thereby providing a highly efficient and reliable technique for honing a conical bore.

It is another important object of this invention to provide a honing tool which is simple and inexpensive to manufacture, and yet which is sturdy and durable in construction. Additionally, the instant inventive concept permits the replacement of honing stone holders when the honing stones carried thereby wear out thereby facilitating maintenance and insuring accurate honing of a conical bore.

Still another object of the instant invention is the provision of a honing tool which is easily used by an inexperienced operator, the tool automatically adjusting itself to the particular configuration of the conical bore.

Additionally, this invention contemplates the provision of a honing tool wherein the tension to be applied on the honing stone can be readily varied and wherein a limiting means is provided to limit the extent of variation of the tension on the honing stones.

Other and further objects reside in the combination of elements, arrangement of parts and features of construction.

Still other objects will in part be obvious and in part be pointed out as the description of the invention proceeds and as shown in the accompanying drawings wherein:

FIG. 1 is a longitudinal sectional view through a preferred embodiment of a honing tool according to the instant inventive concepts;

FIG. 2 is a transverse sectional view through the honing tool along the line A—A of FIG. 1 with the honing stone holders in the maximum expanded position;

FIG. 3 shows the same sectional view as in FIG. 2, but with the honing stone holders in the minimum expanded or retracted position;

FIG. 4 shows a sectional view through the honing tool along the line B—B of FIG. 1;

FIG. 5 is a fragmentary view of the outer body with the clamping nut removed and illustrating the relationship of the torsion spring to the outer body;

FIG. 6 shows a fragmentary elevation of the outer body showing the guide means defined therein for reception of the honing stone holders;

FIG. 7a is a side view of a preferred embodiment of a honing stone holder with a honing stone embedded therein;

and FIG. 7b is a front end view of a honing stone holder according to FIG. 7a.

Like reference characters refer to like parts throughout the several views of the drawings.

The basic objects of the instant invention are satisfied by a honing tool having a central spindle at one end of which an expanding means is fixed, with an outer body mounted rotatably on the central spindle and with honing stone holders guided in the outer body and operatively engaged by the expanding means for movement between a retracted or minimum expanded position and a maximum expanded position on rotation of the central spindle relative to the outer body, with a means for tensioning the central spindle and the outer body for rotation relative to each other.

In FIG. 1 the reference numeral 1 designates the central spindle of a honing tool according to this invention with the central spindle having one end slightly thickened as shown at the right side of FIG. 1, this portion serving as a handle. The other end of the central spindle 1 carries an expanding means 2. In the preferred embodiment shown in the drawing, the expanding means 2 includes eccentrically arranged, cylindrical pins fixedly secured to the end of the central spindle 1, as many pins being provided as there are honing stone holders to be used. For illustration, the drawing shows two honing stone holders 4 arranged opposite one another, and accordingly there are also two expanding pins 2 arranged opposite one another. Of course, it will be readily recognized that additional expanding pins 2 and additional honing stone holders 4 may be arranged in a similar manner in the honing tool of this invention.

An outer body 3 is rotatably mounted on the central spindle 1. At one end thereof, the outer body 3 has a plurality of, at least two, guide means in the form of slots 3a which extend into the interior of the bore in the outer body, and into which are inserted the honing stone holders 4 with the honing stones 5 embedded therein. Once again it will be seen that a guide slot such as 3a is provided for each honing stone holder 4 and the slots are
arranged according to the number of honing stone holders 4 to be utilized. The end of the outer body provided with the slots 3a is conically shaped as will be seen in FIG. 6. The honing stone holders 4 are bevelled and rounded at the side remote from the honing stones 4a as will be seen particularly in FIG. 7a and they abut on the expanding pins 2 and are held in their position with holding springs 9, shown schematically, in the form of helical ring springs. According to the preferred embodiment shown in the drawing the honing stone holders 4 have one side which is bevelled or angled with respect to its opposite side and the expanding pins 2 are cylindrical. This permits the honing stones 4a to be arranged in a generally conical fashion on the honing tool. Alternatively, the conical relationship of the operative surfaces of the honing stones 4a can be provided by using honing stone holders which have generally parallel opposite sides and conical expanding pins (not shown).

The outer body 3 carries, preferably threadably, a clamping nut 5 on which is formed a shoulder 5a spaced from the surface of the outer body 3. In this gap formed by the projecting shoulder 5a there is arranged a torsion spring 6, one end of which is anchored in the clamping nut 5 as shown in FIG. 1. The other end of the torsion spring 6 includes a securing or set screw 8 with which it can be fixed in a selected adjusted position on the outer body 3. Cut into the outer body 3 is a transverse slot 3b which extends into the central bore of the said body. From this transverse slot 3b projects a holding pin 7 which is secured to the central spindle 1. The other end of the torsion spring 6 is hook-shaped and hung on the holding pin 7. Transverse slot 3b and pin 7 limit the position of central spindle 1 and outer body 3 relatively to one another. As shown in FIG. 4 the preferred practical torsional angle is approximately 20°.

When honing conical bores, the workpiece is generally rotated. To bring the honing tool into action, the clamping nut 5 is turned on the outer body 3 to subject the torsion spring 6 to a predetermined preload and the clamping nut 5 is then fixed to the outer body 3 in this selected adjusted position by the securing screw 8. In this position, the expanding pins 2 press the honing stone holders 4 into their maximum expanded position as shown in FIG. 2. To introduce the honing tool into a conical bore, the tool is held on the one hand by the handle of the central spindle 1 and on the other hand at the clamping nut 5 and the parts are rotated relatively to one another, whereby the holes 8 in the honing stone holders 4 are pressed into the minimum expanded or retracted position as shown in FIG. 3. The honing tool can then be introduced into the bore. After releasing the clamping nut 5, the torsion spring 6 rotates the central spindle 1 relative to the outer body 3 so that the honing stone holders 4 are pressed outwardly until the honing stones 4a, independently of any axial travel, abut on the bore and thus have a grinding action. In this way the surface is processed over the entire length of the conical bore, obtaining the improvement in geometric shaped and surface quality hitherto known from the honing of cylindrical bores, but not possible with cylindrical bores until the development of this invention.

Thus, it will now be seen that there is herein provided an improved method and means for honing conical bores which satisfy all of the objects of the instant invention, and others, including many advantages of great practical utility and commercial importance.

Since there may be many embodiments of the instant inventive concepts and since many modifications may be made of the embodiments herein before shown and described, it is to be understood that all matter herein is to be illustrative and not in a limiting sense.

Accordingly, what is claimed is:

1. A device for honing conical bores comprising an outer body having a central axis, guide means defined in said outer body, honing stone holders guided by said guide means for movement between a retracted position and an expanded position relative to said central axis said honing stone holders having stone holding surfaces for supporting such stones at an angle to conform to a conical bore, a spindle rotatably mounted centrally within said outer body, expanding means carried by one end of said spindle and operatively engaging said honing stone holders for movement of the same between said retracted position and said expanded position on rotation of said spindle relative to said outer body, and resilient coupling means for adjusting, during operation, the relative rotational positions of said spindle and said outer body.

2. The device of claim 1 further including securing means limiting the relative rotation of said spindle and said outer body.

3. The device of claim 2 wherein said securing means includes a transverse slot defined in said outer body and a securing pin positioned in said slot and fixed to said spindle.

4. A device for honing conical bores comprising an outer body having a central axis, guide means defined in said outer body, honing stone holders guided by said guide means for movement between a retracted position and an expanded position on rotation of said spindle relative to said central axis, a spindle rotatably mounted centrally within said outer body, expanding means carried by one end of said spindle and operatively engaging said honing stone holders for movement of the same between said retracted position and said expanded position on rotation of said spindle relative to said outer body, and resilient means for tensioning said spindle and said outer body for relative rotation therebetween and wherein said expanding means includes longitudinally extending pins arranged eccentrically of said central axis and operatively engaging each of said honing stone holders.

5. The device of claim 4 wherein said honing stone holders have opposite sides, one of which carries a honing stone, said sides being bevelled with respect to each other, and said pins each being cylindrical and each pin operatively engaging the side of its related honing stone holder opposite to the side carrying the honing stone.

6. The device of claim 5 wherein said sides of said honing stone holders operatively engaged by said pins are rounded.

7. The device of claim 1 wherein said outer body and said spindle are resiliently coupled and tensioned for relative rotation by a torsion spring, a clamping nut rotatably carried on said outer body and operatively engaging said torsion spring to adjust the tension produced thereby, and means for securing said clamping nut to said outer body in a selected adjusted position.

8. A device for honing conical bores comprising an outer body having a central axis, guide means defined in said outer body, honing stone holders guided by said guide means for movement between a retracted position and an expanded position relative to said central axis, a spindle rotatably mounted centrally within said outer body, expanding means carried by one end of said spindle and operatively engaging said honing stone holders for movement of the same between said retracted position and said expanded position on rotation of said spindle relative to said outer body, and resilient means for tensioning said spindle and said outer body for relative rotation therebetween and wherein said guide means include a slot defined in said outer body for each of said honing stone holders, said expanding means including longitudinally extending pins arranged eccentrically of said central axis, spring means urging said honing stone holders into operative engagement with said pins, a clamping nut rotatably carried on said outer body, a torsion spring having one end secured to said clamping nut, a transverse slot defined in said outer body and a securing pin positioned in said slot and fixed to said spindle, the other end of said torsion spring carried by said securing pin whereby rota-
tion of said clamping nut on said outer body adjusts the tension produced by said torsion spring for relative rotation of said spindle and said outer body, and the engagement of said securing pin against the extremities of said transverse slot limits the relative rotation between said spindle and said outer body.

9. The device of claim 8 further including a set screw carried by said clamping nut and operatively engaging said outer body for securing said clamping nut to said outer body in a selected adjusted position.

10. A method for honing conical bores comprising retracting a plurality of honing stones arranged on a honing tool in a generally conical fashion so that the operative surfaces of said honing stones are smaller than the conical bore to be honed, rotating the workpiece containing the conical bore, positioning the tool so that the honing stones are within the conical bore, and expanding the honing stones so that the operative surfaces thereof engage the conical bore thereby creating a frictional force therebetween, and resiliently urging the honing stones to the expanded relationship and into operative engagement with the conical bore such that the honing stones adapt themselves to the configuration of a conical bore and press against the bore with an effective contact pressure related to said frictional force during operation.

11. A device for honing conical bores comprising an outer body having a central axis, guide means defined in said outer body, honing stone holders guided by said guide means for movement between a retracted position and an expanded position relative to said central axis, a spindle rotatably mounted centrally within said outer body, expanding means carried by one end of said spindle and operatively engaging said honing stone holders for movement of the same between said retracted position and said expanded position on rotation of said spindle relative to said outer body, and resilient means for tensioning said spindle and said outer body for relative rotation therebetween and wherein said outer body and said spindle are resiliently coupled and tensioned for relative rotation by a torsion spring, a clamping nut rotatably carried on said outer body and operatively engaging said torsion spring to adjust the tension produced thereby, and means for securing said clamping nut to said outer body in a selected adjusted position.

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