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GRINDING WORKHEAD

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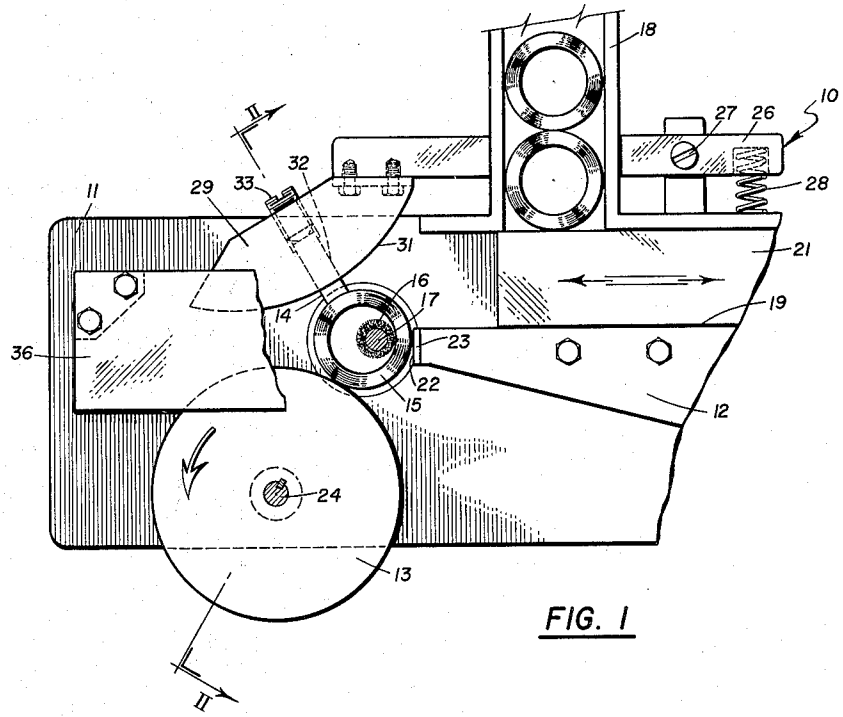


FIG. 1

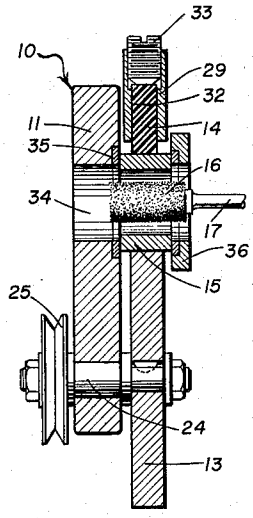


FIG. 2

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GRINDING WORKHEAD

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This invention relates to a grinding workhead and, more particularly, to apparatus arranged to finish a surface of revolution of an annular workpiece by the abrasion method.

In the grinding of annular workpieces and, particularly, in the the internal grinding of bores, it is necessary to hold the workpiece in a fixed, known position relative to the remainder of the grinding machine. At the same time, it is necessary to provide a holding means into which it is possible readily to remove old workpieces and introduce new ones. The requirements become difficult to satisfy in the case of small workpieces of the type represented by the races of miniature ball bearings. The apparatus used for this purpose in the past has been rather intricate and expensive. Furthermore, because of their complexity they have been readily disabled, so that the machine does not operate properly. The economic disadvantages of permitting an expensive grinding machine to be out of operation for even a short length of time are obvious. These and other difficulties experienced with the prior art devices have been obviated in a novel manner by the present invention.

It is, therefore, an outstanding object of the present invention to provide a grinding workhead having a simple, inexpensive means of holding small annular workpieces and permitting the replacement of a finished workpiece by an unfinished workpiece with a minimum of difficulty.

Another object of this invention is the provision of a grinding workhead having a novel means for holding the workpiece and permitting rapid unloading and loading.

A further object of the present invention is the provision of a grinding workhead in which the workpiece is securely held in a pre-determined position but may be readily rotated at a desired speed relative to the speed of rotation of the abrasive wheel.

It is another object of the instant invention to provide a grinding workhead of relatively simple and inexpensive construction.

With these and other objects in view, as will be apparent to those skilled in the art, the invention resides in the combination of parts set forth in the specification and covered by the claims appended hereto.

The character of the invention, however, may be best understood by reference to one of its structural forms as illustrated by the accompanying drawings in which:

FIG. 1 is an elevational view of a portion of a grinding machine embodying the principles of the present invention, and

FIG. 2 is a sectional view of the invention taken on the line II—II of FIG. 1.

The grinding machine, indicated generally by the reference numeral **10**, is shown as consisting of a workhead **11** on which are mounted a shoe **12**, a disk **13**, and a pressure member **14**. A workpiece **15** is shown as held between the shoe **12**, the disk **13**, and the pressure member **14**, while an abrasive wheel **16** mounted on a spindle **17** is shown finishing the internal bore of the workpiece. The workpiece is shown as an annular member similar to the outer race of a ball bearing. The grinding machine **10** is similar to that shown in the application of Townsend et al., Serial Number 158,974, filed December 13, 1961; it is particularly intended for use in grinding the races of miniature ball bearings, and it will be understood that the workpiece **15** shown in the drawings and all of the parts associated therewith are much larger than would be the actual situation. This is done for the purpose of clarity of illustration.

Mounted on the workhead **11** is a chute **18** containing unfinished workpieces. The shoe **12** is bolted to the workpiece and is provided with a horizontal upper edge **19** defining with the bottom of the chute **18** a horizontal passage containing a pusher **21** which is reciprocated in a well-known manner to press an unfinished workpiece into working position, after the preceding workpiece has been finished. The shoe **12** is provided with a contact surface **22** which extends at a right angle to the upper edge **19**. This surface may be provided with a hardened metal insert **23** preferably formed of a high-friction, hard material such as tungsten carbide.

The disk **13** is perfectly circular and is keyed to a shaft **24** extending through the workhead **11** and provided with a drive pulley **25**. This pulley is driven in a well-known manner to provide for rotation of the disk **13** in such a way that, at its point of contact with the workpiece, its peripheral surface moves in a direction away from the shoe **12**.

A support arm **26** is mounted on the workhead **11** for rotation about a pivot **27** and a spring **28** extends between the arm **26** and the workhead to produce a spring bias of the arm toward the vicinity of the workpiece. Mounted on the end of the arm overlying the workpiece area is a guide member **29** having a formed edge **31** which is shown in the preferred embodiment as a segment of a circle having a radius center of curvature located on an imaginary line extending between the center of the workpiece **15** and the portion of the workpiece contacted by the pressure member **14**. A bore **32** extends through the guide member in line with the radius of the edge **31**. Slidably mounted in this bore is the pressure member **14** which, for the purposes of illustration, is shown as being in the form of a rod and made of a low-friction elastomer material, such as a polymer of tetrafluoroethylene, commonly known as Teflon. A set screw **33** is threaded in the outer end of the bore **32** to provide for adjustment of the pressure member with wear.

Extending through the workhead **11** is a bore **34** intended to provide room for the abrasive wheel **16** to move through the workpiece and also to provide for the introduction of a gauge (not shown) into the workpiece on occasion. Surrounding the edge of the bore **34** where it contacts one end of the workpiece **15** is an inlaid annular insert **35** formed of tungsten carbide. The bore **34** is larger than the bore of the workpiece even in its finished condition. Also bolted to the workhead is an outboard platen **36** which engages one end of the workpiece to hold it in place and is provided with a bore **37** to permit the introduction of the wheel without interference.

The operation of the invention will now be readily understood in view of the above description. An unfinished workpiece in the chute **18** will drop onto the upper edge **19** of the chute **12** when the pusher **21** is in the right-hand position. Then, when the pusher moves to the left, it will press the unfinished workpiece along the upper edge **19** until it contacts the formed edge **31** of the guide member **29**. Further movement by the pusher **21** will cam the guide member **29** and the support arm **26** upwardly against the pressure of the spring **28**. This action will lift the pressure member **14** from contact with the finished workpiece **15** and further movement will cause the new, unfinished workpiece to press the old, finished workpiece away from the contact surface **22** of the shoe **12**. The abrasive wheel **16**, of course, is withdrawn at this time in the usual manner. The finished workpiece will roll over the edge of the disc **13**, being assisted in this motion by the movement of its periphery. The new

workpiece will drop over the corner formed by the upper edge 19 of thes shoe 12 and the contact surface 22 and will drop into place so that it contacts the edge 22, the peripheral edge of the disc 13, and the pressure member 14. In the preferred embodiment, the engagement of the contact surface 22 with the workpiece will be at the portion known as "three o'clock." The peripheral edge of the disc 13 will also contact the workpiece at a position removed by 120° from the position of contact by the shoe 12, this position being approximately "seven o'clock." The pressure member 14 will engage the outer surface of the workpiece at a position 120° removed from the other positions of contact in an area known as "eleven o'clock." Although the contact surface 22 is shown as a plane surface which, theoretically, will engage the workpiece with line contact, it will be understood that a curved contact surface may well be used. Since the nature of the pressure member 14 is such as to wear relatively easily (at least as compared with tungsten carbide) the contact of the pressure member with the workpiece will probably be a cylindrical area.

It can be seen, then, that the position of the workpiece is determined very definitely by the hardened contact surface 22 of the shoe 12. As a matter of fact, when the abrasive wheel 16 is introduced and is fed into grinding contact with the surface of the bore, it does so on a radial line with the point of contact of the outside surface of the workpiece with the contact surface 22. This permits workpieces to be readily reproduced in the grinding machine, so that successive workpieces will be exactly the same size. The driving of the workpiece takes place by the frictional contact between the cylindrical peripheral surface of the disc 13 and the outer surface of the workpiece. The pressure member 14 maintains the workpiece securely pressed against the two members, the shoe 12 serving to locate the workpiece and the disc 13 serving to drive it. However, because of the selection of materials, the low friction characteristics of the pressure member 14 assures that it does not slow down the rotation of the workpiece, it being understood that, in grinding practice, it is necessary for the workpiece to rotate. The speed of its inner peripheral surface is, of course, not as fast as the peripheral surface speed of the wheel 16, but nevertheless, it is necessary that the workpiece be rotated. Although the surface 22 of the shoe 12 is hard and presents a good surface for locating the workpiece, its high frictional characteristics prevent the workpiece from rotating too fast. A proper balance of friction between the driving surface of the disk 13, the retarding and locating surface of the shoe 12, and the pressure surface of the pressure member 14 is desirable, and has been suitably provided by the present invention.

It is obvious that minor changes may be made in the form and construction of the invention without departing from the material spirit thereof. It is not, however, desired to confine the invention to the exact form herein shown and described, but it is desired to include all such as properly come within the scope claimed.

The invention having been thus described, what is claimed as new and desired to secure by Letters Patent, is:

1. A grinding workhead for use in finishing a surface of revolution of an annular workpiece, comprising

(*a*) a workhead base,

(*b*) a shoe fastened to the workhead and having a fixed surface adapted to contact a first portion of the outer surface of the workpiece,

(*c*) a disc mounted on the workhead base for rotation about a fixed axis and driven to present a moving peripheral surface adapted to contact the outer surface of the workpiece at a position substantially spaced from the said first portion, the periphery of the disc at the position where it contacts the workpiece traveling in the direction away from the shoe, and

(*d*) a pressure member having a friction portion which, during grinding, is fixed relative to the workhead base and mounted on the workhead base for movement toward and away from the shoe and the disc, the pressure member being adapted to contact a second portion of the outer surface of the workpiece located in such a position relative to the said first portion and the said position that the workpiece is firmly held in place, the said friction portion resisting rotation of the workpiece to produce a differential speed between the workpiece and the wheel.

2. A grinding workhead as recited in claim 1, wherein the shoe is formed of a very hard, high-friction material.

3. A grinding workhead as recited in claim 1, wherein the shoe is formed of tungsten carbide.

4. A grinding workhead as recited in claim 1, wherein the pressure member is formed of a low-friction elastomer material.

5. A grinding workhead as recited in claim 1, wherein the pressure member is formed of a polymer of tetrafluoroethylene.

6. A grinding workhead as recited in claim 1, wherein the disc is driven so that its peripheral surface at the said position moves in a direction away from the said shoe.

7. A grinding workhead as recited in claim 1, wherein the pressure member is carried by a support arm which is pivotally mounted on the workhead and is spring-biased to press the pressure member toward the workpiece.

8. A grinding workhead as recited in claim 7, wherein the support arm is provided with a guide portion having a shaped surface extending on either side of the pressure member to guide successive workpieces in and out of working position.

9. A grinding workhead as recited in claim 8, wherein the pressure member is in the form of a rod and lies in a bore extending into the guide portion in a direction radial of the workpiece.

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