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APPARATUS FOR CHUCKING CYLINDRICAL WORKPIECES ON GRINDING MACHINES

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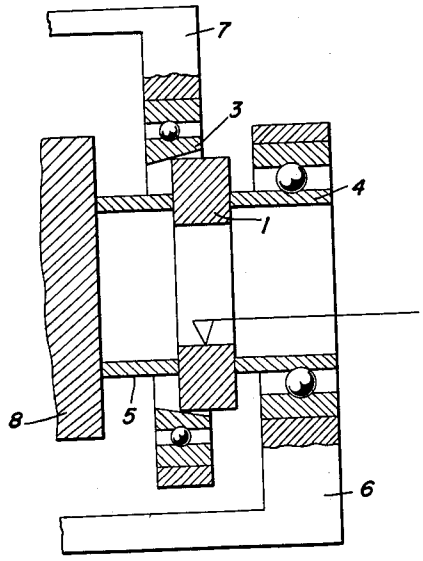

Fig. 1.

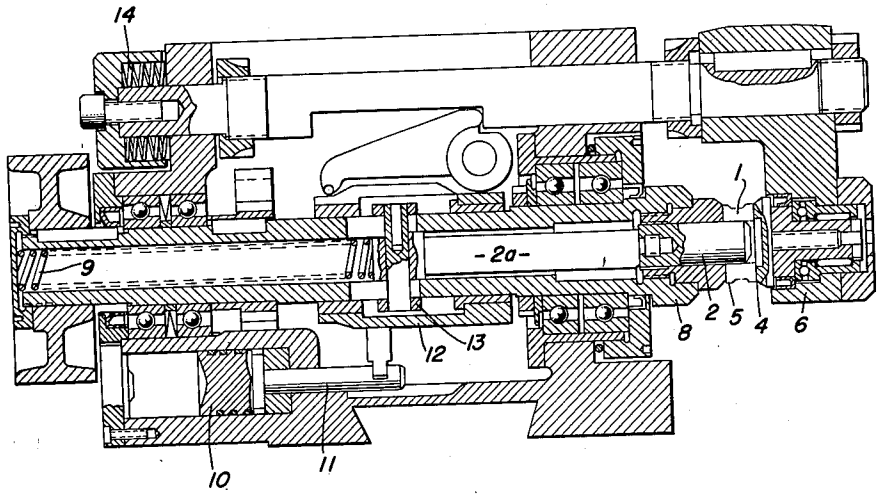

Fig. 2.

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APPARATUS FOR CHUCKING CYLINDRICAL WORKPIECES ON GRINDING MACHINES

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The invention relates to an apparatus for fixing cylindrical workpieces by the engagement of a cylindrical surface with a conical clamping surface, such as is necessary particularly for chucking ball-bearing races on grinding machines.

The apparatus mostly employed for chucking hollow cylindrical workpieces such as the inner races of ball bearings for working the raceways by grinding or the like, includes means to thread the rings on an accurately centered solid mandrel. In so doing, care must be taken that the wall of the mandrel on which the inner race sits runs absolutely true. Using apparatus of this type, sufficiently accurate rotation can only be attained when the workpiece bears with a press fit along its entire length on the mandrel, which, strictly speaking, is only the case in the region of the greatest diameter of the mandrel in engagement with the workpiece. If extremely accurate work is required, the peripheral and wobbling oscillations of the workpiece must be avoided so that neither eccentricity occurs when working the outer surface of the workpiece nor inclination of the worked surface to the axis of the cylinder. This ideal state of affairs could not quite be attained by using cones with slight conicity. Another objection to this solution is that very long cones must be used, whereby in addition the bore tolerance demands still further lengthening of the chucking cone or the use of several such cones with different clamping ranges. Consequently different types of expanding mandrels have been produced recently so as to avoid these difficulties. These expanding mandrels cannot, however, be used for small workpieces for reasons of construction.

In order to be able to attain sufficient accuracy of shape in the case of small rings, the procedure has recently been introduced when grinding the inner races of ball-bearings, of first grinding the raceway of the races and then grinding the bore starting from the raceway, by the centerless method. However, the ball bearing raceway is detrimentally affected by the bearing of the rollers and the further objection arises that although uniform wall thicknesses can be produced theoretically by this method, the tolerance of the outer diameter of the groove is copied when grinding the bore.

The object of the present invention is to avoid these objections by devising an apparatus for fixing cylindrical workpieces, particularly ball-bearing races on grinding machines by the engagement of a cylindrical surface with a cone. The workpiece, according to this invention, is held between two surfaces extending at right angles to the axis of the cone, so that it is shiftable transversely to the axis of the cone, is centered by displacing the cone in its axial direction and firmly clamped by pressing the flat surfaces towards each other.

This is attained by arranging the elements serving to support the workpiece against deflection from the true path at right angles to the axis of the cone, outside the cone. This method therefore can be used primarily for chucking workpieces of very small dimensions in a very advantageous manner and that the devices for carrying out the method are of very simple construction.

According to this invention, such a device consists, of two flat surfaces which engage the workpiece from opposite sides and are arranged substantially concentrically

with the cone. Also, the cone and the flat surfaces are shiftable in relation to each other axially of the cone.

It is possible with the device according to this invention to chuck workpieces both externally as well as internally. If the workpiece is to be chucked on the outer side, the cone is, a hollow cone and the flat face arranged concentrically inside the hollow cone. If the workpiece is to be chucked on the inner side, for example to enable ball-bearing inner races to be worked on the outer side, the cone is a solid cone and the flat surfaces are arranged concentrically outside the cone.

According to another proposal of this invention, the surface facing the driving side of the machine is rigid in longitudinal direction, whereas the cone is shiftable relative to this surface and the other surface is shiftable relative to the first-mentioned surface and to the cone.

Another practical constructional feature according to the invention is that the cone comes into engagement with and remains in contact with the workpiece under the action of spring force and the spring action is relieved when removing the workpiece from the cone.

Yet another proposal according to this invention has for its object to allow the surface remote from the cone to bear against the workpiece under the action of a spring during the grinding operation, this spring being so dimensioned that it ensures the entrainment of the workpiece.

Particularly short chucking times are obtained if the retraction of the mandrel and the removal of the surface opposite the cone take place simultaneously.

Another important advantage of the method and device according to the present invention is the possibility of fully automatic chucking and unchucking.

Several embodiments of the invention are hereinafter described with reference to the accompanying drawings, in which:

FIG. 1 is a diagrammatic cross-section of a device according to the invention for chucking workpieces to be worked from the inner side, and

FIG. 2 is a longitudinal section through a part of a grinding machine fitted with a chucking device according to the invention for internal chucking.

In FIGS. 1 and 2 the workpiece is designated by **1**, the solid cone by **2**, the hollow cone by **3** and the flat bearing or supporting surfaces by **4** and **5** respectively, while **6** is an arm mounted for axial reciprocation and rotatably carrying the surface **4**. Reference **7** in FIG. 1 designates the arm for holding the hollow cone **3**, while **8** designates the spindle of the machine on which the workpiece **1** is to be mounted.

In FIG. 2 a spring **9** is shown for pushing the cone **2** into the bore of the workpiece **1**, which spring is introduced between the pressure member, not shown, and the cone **2** to ensure that the cone sits absolutely tightly in the inner race so that any play between the mandrel and the bore is taken up.

When retracting the mandrel, however, the spring **9** is inoperative because in this case the hydraulic retracting device which comprises a hydraulic piston **10** and interconnecting linkage **11** and sleeve **12** is effective to withdraw the mandrel by contacting the abutment **13** with an inner part of the sleeve **12**. **14** designates a pressure spring which is arranged to bias the arm **7** to the left as shown in FIGURE 2 so that, during the grinding operation, the arm **6** bears resiliently against the workpiece **1** and causes it to be entrained. The spring **14** is stronger than the spring **9**.

It is preferable when fixing the workpiece on a grinding machine according to FIG. 2 to proceed in the following manner:

During the introduction of the workpiece, the mandrel **2** which has a conical end, is retracted until it is flush with the flat surface **5**. At the same time the

surface 4 is shifted a few tenths of a millimeter further towards the right than the length of the workpiece. The workpiece is now swung between the two surfaces 4 and 5 by means of a lever or the like capable of swivelling transversely to the axis of the mandrel but not shown in the drawing, and is held loosely so that it is easily shiftable in the swivel plane of the lever until the cone 2 has penetrated the bore of the workpiece, the end face of which bears against the surface 4. When the workpiece has been engaged by the cone, the lever is swung away, whereupon the cone 2 penetrates under the action of the spring 9 so far into the bore of the workpiece 1, until it sits tightly and there is no play between the cone 2 and the bore of the workpiece 1. Consequently the workpiece is perfectly centered. In order to maintain it in this position, the surface 4 is shifted towards the workpiece in the axial direction of the cone until it bears tightly against the surface 5. The pressure exerted by the spring 14 is so calculated that entrainment of the workpiece is ensured during the working operation.

The removal of the workpiece is then effected by reversing this procedure. When the workpiece has been ground, the surface 4 is shifted a few tenths of a millimeter off the workpiece, the cone 2 pulled back with the aid of the hydraulic retracting device 10—12 without the aid of the spring 9, whereupon the workpiece drops out of the machine. These two operations should preferably be carried out simultaneously.

In this manner it is possible to introduce into and remove from the machine even the smallest workpieces mechanically and automatically, to compensate them in diameter without play and consequently to attain a degree of precision work hitherto impossible, especially in the case of small workpieces. It is evident that the arrangement according to the invention can also be used equally advantageously for workpieces of large dimensions.

Another advantage of the device according to the present invention is that the conicity of the cone need be selected merely in relation to or merely in consideration of the tolerance of the bore of the workpiece but not with a view to obtaining as near as possible an ideal press fit.

I claim:

1. Apparatus for fixing cylindrical workpieces concentrically with the axis of a rotatable spindle comprising: a first annular member on one end of the spindle, said member having a flat bearing surface for supportingly engaging one end of the workpiece; centering means having a conical surface concentric with the spindle axis, said centering means being movable axially with respect to said first member so that the conical surface thereof is operable to constrain the workpiece to a position of true concentricity with the spindle axis; a second annular member having a flat bearing surface for supportingly engaging the other end of the workpiece; an arm rotatably supporting said second member, said arm being shiftable on an axis parallel with the spindle axis; and spring means biasing and maintaining said centering means in engagement with the workpiece while the workpiece is held between the bearing surfaces of the annular members and during machining operations on the workpiece.

2. The apparatus recited in claim 1, in which the spindle is tubular and said centering means is disposed within the spindle, said conical surface diverging away from the workpiece to be receivable in a central bore in the workpiece.

3. The apparatus recited in claim 1, in which said conical surface diverges toward the workpiece to be engageable with the outer periphery thereof.

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