

March 8, 1960

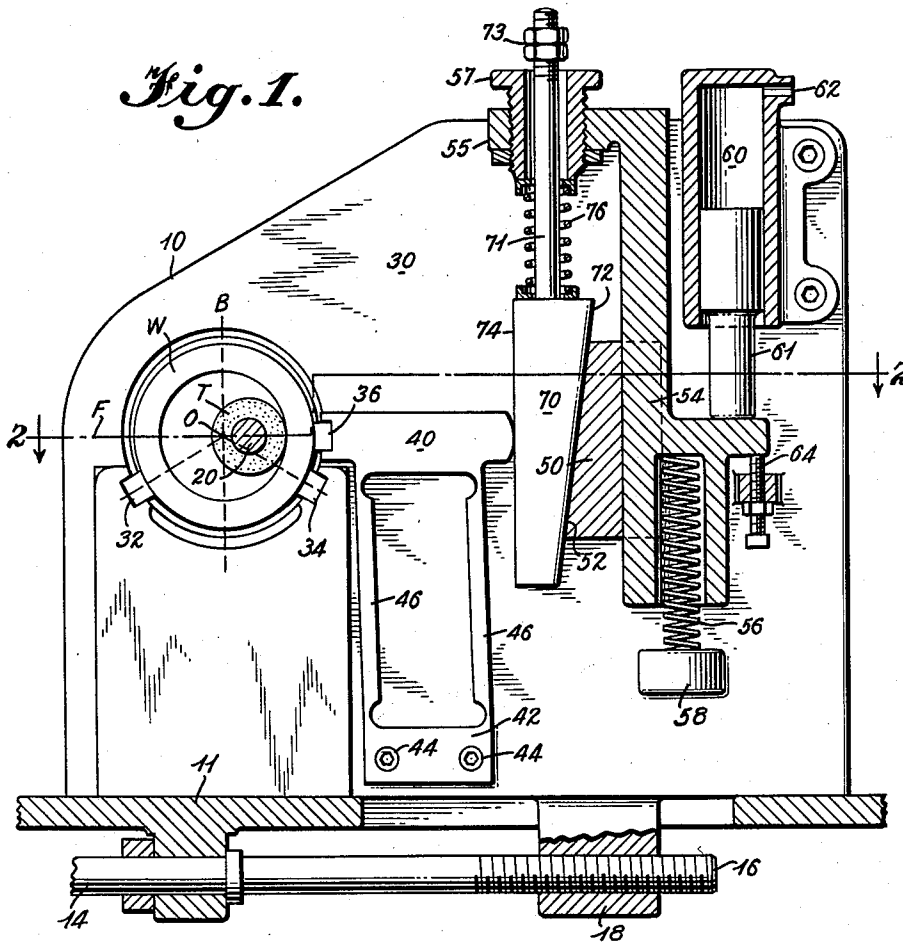
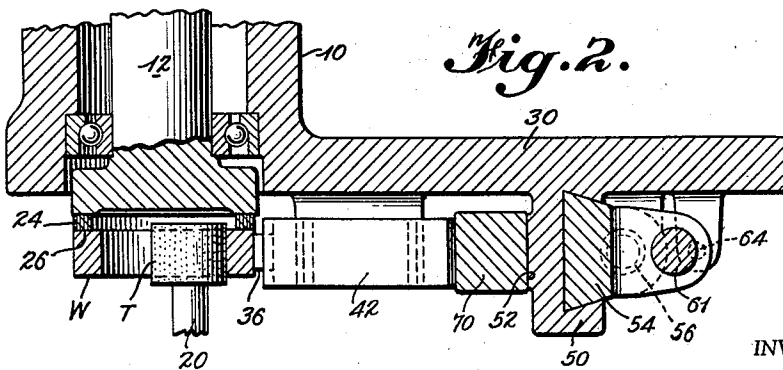
R. CANN

2,927,408

RADIAL WORK SUPPORT FOR CENTRIC GRINDING MACHINE

Filed June 3, 1958

3 Sheets-Sheet 1



INVENTOR

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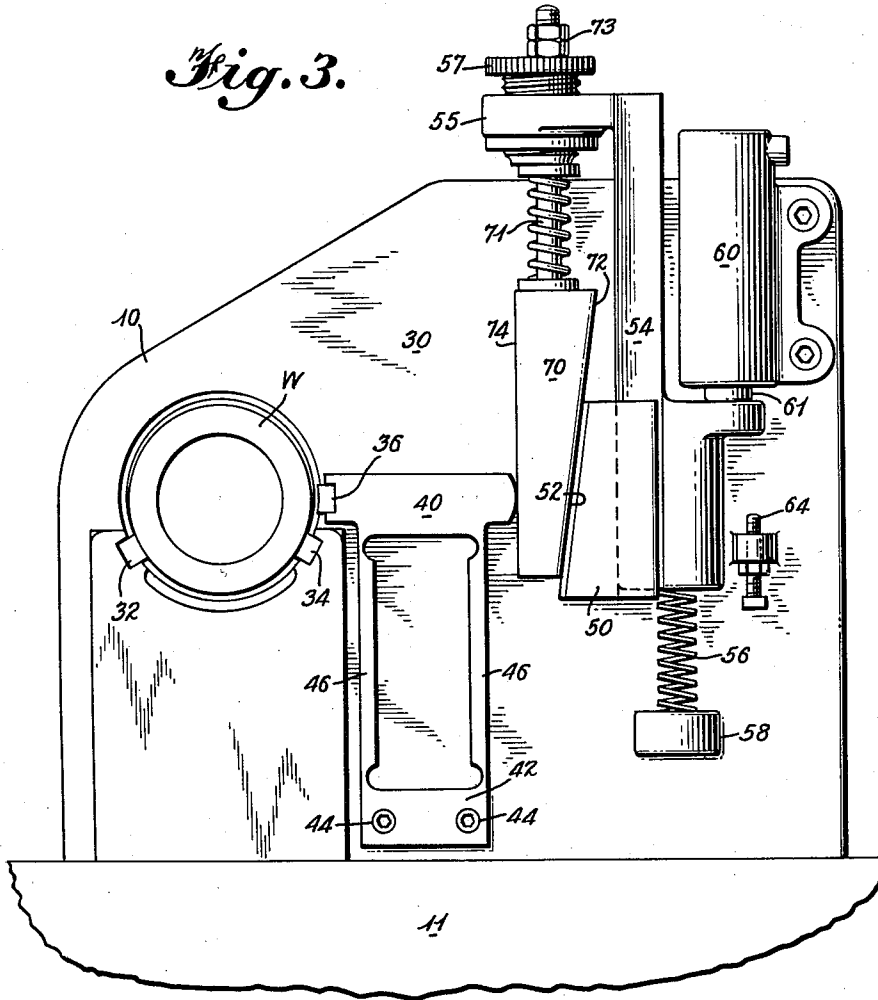
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RADIAL WORK SUPPORT FOR CENTRIC GRINDING MACHINE

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3 Sheets-Sheet 2



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Fig. 4.

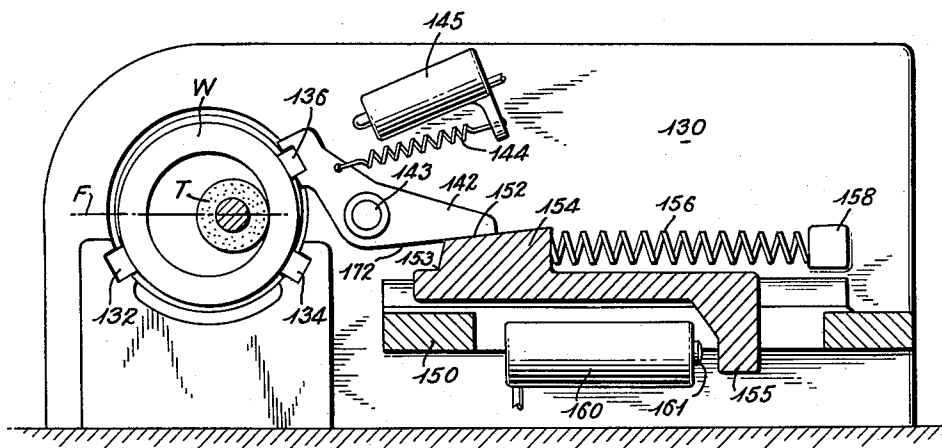
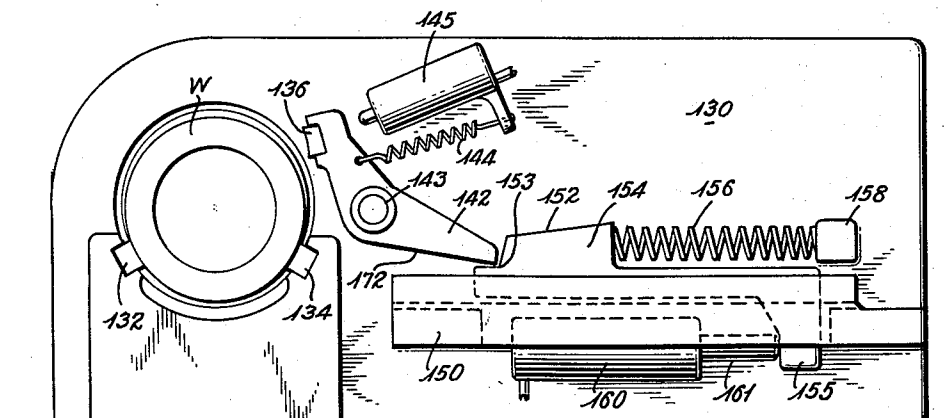


Fig. 5.



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RADIAL WORK SUPPORT FOR CENTRIC GRINDING MACHINE

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Application June 3, 1958, Serial No. 739,562

4 Claims. (Cl. 51—103)

This invention relates to improvements in internal centric grinding machines wherein an annular workpiece is rotated about a support determined axis whilst a preformed outside periphery of the workpiece is radially supported on support means angularly spaced along the preformed periphery, and a tool is applied to the workpiece to generate a surface about the support determined axis coaxial to the preformed periphery.

Typical annular workpieces to be refined in grinding machines of this type are raceway rings for annular anti-friction bearings, which must be produced at a fast rate while holding narrow tolerance limits in regard both to concentricity and diametrical dimensions. A preferred method of sizing the workpieces is by, what commonly is termed, "diamond-sizing," i.e., a relative transverse feed movement between the support determined axis of the workpiece and the axis of the grinding tool is produced, this feed movement being of a constant predetermined linear amount along a line of feed; and with the added provision of periodically dressing the grinding tool while repositioning to restore the initial relationship between the axis of the workpiece and the axis of the grinding tool whereby the leading edge of the grinding tool will retain a predetermined distance along the line of feed relative the support determined axis of the workpiece. Bearing in mind that the supported outside perimeter of the exemplified type of workpiece normally has a comparatively wide tolerance allowance of, e.g., .003", and the internal surface to be generated must be held much closer at, e.g., .0003", aforesaid radial support means could suitably be two angularly spaced supports where the bisector of the angle therebetween is normal to the line of feed. Such an arrangement of the radial support means would automatically position the workpiece with its support determined axis on this bisector, although, because of aforesaid tolerance spread, this axis may be slightly above or below the line of feed, however, there is practically no detrimental effect on the size control of the dimension desired. On the other hand such described support means, although practically feasible, have certain limitations in regard to possible rate of grinding speed, and often requires auxiliary seating means for the workpiece in the form of pressure rollers, or the like, to counteract the grinding forces. Such pressure means are particularly undesirable when applied to workpieces having a small easily distortable cross section.

The proper solution to achieve a stable seating of the workpiece is to provide a third support where a wall of the workpiece is interposed between the grinding tool and this third support. However, to be effective, this third support, because of aforesaid diametrical variations of its perimeter, must be adjustable so it will positively contact consecutive workpieces when positioned on the angularly spaced support means.

It is therefore an object of this invention to provide axis determining support means for an annular workpiece, this means comprising two support elements angularly spaced from a bisector normal to the line of feed,

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in combination with a third support element located on, or in proximity of, this line of feed in the path of the grinding forces acting on the workpiece.

Another object is to arrange the third support element to in all instances retain contact with a preformed surface of a workpiece seated upon the angularly spaced supports during grinding with the rotative axis of the workpiece on the bisector of the angle between the spaced supports.

Still another object is to provide a positioning device for the third support element to place it in contact with the perimeter of the workpieces irrespective of diametrical variations thereof.

Other objects and advantages encompassed by the invention will be apparent from the following description taken in reference to accompanying drawings which disclose, by way of example, the principle of this invention and the best mode which has been contemplated of applying that principle.

In the drawings:

Figure 1 is an elevational view, partly in section, showing the elements of the invention supporting a workpiece in an internal centric grinding machine during a grinding phase of operation;

Figure 2 is a sectional view taken along line 2—2 of Figure 1;

Figure 3 is an elevational view, partly in section, similar to Figure 1, but with the apparatus shown positioned for a loading and unloading phase of operation;

Figure 4 is an elevation view, partly in section, illustrating a modification of the invention during a grinding phase of the operation;

Figure 5 is an elevation view, partly in section, similar to Figure 4, but with the apparatus shown positioned for a loading and unloading phase of operation.

In Figures 1 and 2 there is shown a headstock 10 supported on a machine bed 11. A shaft 12 is rotatably supported in the headstock, and is adapted to be driven by conventional means, not shown. In the bed 11 is journaled an axially fixed shaft 14 having a threaded portion 16 in engagement with a threaded portion of a lug 18 depending from the headstock 10 for achieving a feed movement of the headstock assembly transverse to the axis of shaft 12. A rotatable tool spindle 20 supports a tool T adapted to be placed in contact with a workpiece W in a manner and for a purpose well known in the art. The axis of spindle 20 is preferably located in a plane in proximity of the support determined axis of the workpiece, this plane being parallel to the feed movement, and where a line running through the center of spindle 20 defines a line of feed F.

An enlarged portion 22 of shaft 12 carries a magnetic holding device 24 having a face 26 normal to the axis of shaft 12. This face is for axially supporting a workpiece and rotatably driving the same in frictional relationship thereto.

The axis determining means for the rotatable workpiece is supported on an apron 30 which is an integral portion of the headstock 10. These means are primarily two support elements 32 and 34 radially fixed, and angularly spaced about a line B perpendicular to the line of feed F and bisecting the angle formed between elements 32, 34 and the center O of a workpiece W supported thereon. This line is termed the bisecting line. An annular workpiece W supported on the elements 32 and 34 will then, irrespective of its diameter, have its center placed on the bisecting line.

In centric grinding machines a force is present to seat the workpiece against the radial support elements and is, in this described embodiment, derived from an eccentric relationship between the axis of the driver shaft 12 and the support determined axis of the workpiece. This ar-

range forms no part of the present invention and will not be described in detail as being an inherent feature of centric grinding machines and fully disclosed, e.g., in Patent No. 2,635,395 to Arms et al. to which reference may be had.

On the extension of the line of feed F is located a third support element 36 intended to prevent displacement of the workpiece by the normal force of the tool acting on the workpiece. This element 36 is fixedly attached to a portion 40 of a bracket 42 the lower portion thereof being rigidly mounted on the apron 30 by screws 44. The portion 40 is connected with the lower portion by reed-like portions 46—46 having a spring factor constituting yieldable means permitting a limited displacement of portion 40 from a position of repose as shown in Figure 3, towards the support determined axis O.

Apron 30 has an integral portion 50 provided with an inclined plane 52 which is inclined upwardly and away from the axis O as shown in Figure 1. The portion 50 also forms a slideway for a slide 54 which is movable parallel to the bisecting line. A spring 56, acting between the slide 54 and a lug 58 depending from the apron 30, constantly tends to urge the slide upwardly to the position shown in Figure 3. A fluid power motor 60 which through a conduit 62 may be supplied with fluid under pressure from a suitable source, not shown, acts to position the slide 54 against an adjustable stop 64 on the apron as shown in Figure 1. Projecting from the slide 54 perpendicular to the motion thereof is a portion 55 provided with a hole for threaded engagement with a ferrule 57.

An element here termed actuator 70 is interposed between the inclined plane 52 and the end of portion 40 opposite element 36. This actuator is provided on one side with an inclined face portion 72 to mate with the plane 52 and on the other side is provided with a face portion 74 substantially parallel with the bisecting line B. The actuator 70 has an extension in shape of a rod 71 passing through the central hole of the ferrule 57, and the outer end of the rod 71 is threaded for nuts 73 the purpose of which will be explained later. Surrounding the rod 71 is a compression spring 76 acting between the ferrule 57 and the main body of the actuator 70 and biasing the actuator to move element 36 forward axis O. The central hole in the ferrule is larger than the diameter of the rod 71 to permit a lateral motion of the actuator 70.

The operation of the device will now be described, and it is seen in Figure 3, when the motor 60 is without power supply the spring 56 will lift slide 54 to an upper position and the ferrule 57 by contacting nut elements 73 will cause the actuator 70 to participate in the upward motion permitting reed elements 46—46 to take their normal position of repose with the face 37 of element 36 outside and adjacent to an imaginary circle defined by an annular workpiece supported on elements 32 and 34. When a new workpiece is seated on elements 32 and 34, fluid under pressure is introduced to motor 60 with the result that an extension 61 of the motor piston forces slide 54 downwards against the stop 64 as in Figure 1, which stop is adjusted to, in this position, leave a lost motion gap between ferrule 57 and element 73 whereby only the force of spring 76 affects the actuator 70 to move the same downwards thereby causing a wedging action between the fixed plane 52 and the portion 40. Spring 76 is chosen sufficiently strong to overcome the spring factor of reeds 46—46 by a small margin but still less than the aforesaid present seating force and to move support element 36 into contact with the perimeter of the workpiece present, which thereby will be supported at or near the line of feed by the solidly fixed plane 52 through the intermediary of actuator 70, portion 40 and support element 36. From the above it is clear that, after the slide 54 is moved downward by

motor 60 to the predetermined position established by stop 64, the aforesaid gap between nut 73 and ferrule 57 will permit a further movement of actuator 70 in the same direction, and the comparatively gentle force of spring 76 in the described manner urges element 36 against the workpiece and so provides an unyielding resistance against the tooling forces.

Figures 4 and 5 illustrate another embodiment of the invention, wherein an apron 130, support elements 132 and 134 are arranged in like manner and for the same purpose as described for corresponding elements 30, 32 and 34 respectively. A support element 136 corresponds in general to described element 36 with the difference that element 136 is located entirely above the line of feed, and is fixedly attached to a member 142 pivotably mounted on a stud 143 depending from the apron 130. In a portion 150 of the apron 130 is formed slideways for a slide 154 movable parallel to the line of feed. A spring 156 acting between the slide and a lug 158 on the apron constantly tends to urge the slide towards the rotative center of the system. An inclined plane 152 of slide 154 is in mating relationship with another inclined plane 172 on member 142 whilst the parts of the device are in the relative position of Figure 4. A fluid power motor 160 is provided with an extension 161 of the motor piston which acts on a lug 155 of the slide 154, and this extension will, whilst provided with pressurized fluid power medium, move the slide 154 to the position of Figure 5, with the result that the member 142 under influence of a tension spring 144 will pivot clockwise placing its tail end in a notch 153 of the slide 154 thereby latching the member 142 with element 136 in the position shown in Figure 5 remote from an imaginary circle defined by the perimeter of an annular workpiece seated on elements 132 and 134. With a new workpiece thus seated the power medium is removed from motor 160 and a power medium is introduced temporarily to another fluid power motor 145 acting to unlatch the member 142 by pivoting it counter-clockwise an amount sufficient to permit the slide 154 to move to the right under influence of spring 156 thereby placing the inclined planes 152 and 172 in mating relationship as shown in Figure 4, whereafter the power medium is removed from the motor 145. The spring 156 being stronger than spring 144 now supplies the force acting on the member 142 to move the same further and place element 136 in contact with the perimeter of the workpiece in a manner and for purpose analogous to that described for Figures 1, 2 and 3.

The described embodiments are susceptible to sundry variations by one skilled in the art without departing from the spirit and scope of the invention which is entitled to a reasonable range of equivalents as defined by the appended claims.

I claim:

1. In combination a centric internal grinding machine including a headstock supporting a rotatable shaft to axially locate and drive an annular workpiece, a grinding tool adapted to be positioned in working relationship to the interior of the workpiece on which an internal surface is to be generated concentric with a preformed external surface of said workpiece co-axial with a support determined axis being parallel to the axis of the work driver, means to impart a relative transverse motion between the axes of said work driver and tool along a line of feed, and an improved radial work-supporting device, the work supporting device comprising: first and second workpiece support elements in fixed relationship to the headstock, these elements being angularly spaced from an intersecting line normal to the line of feed, and radially positioned to define a periphery of a circle corresponding to the perimeter of the workpiece with its center in proximity of the line of feed; a third support element positioned in proximity of the line of feed where a wall of the workpiece may be interposed between the tool and this

support element, said third support element movably connected to the headstock by yieldable means having a spring factor which, when in repose, locates the third element outside and adjacent to the above-defined circle; and an actuator operable to over-ride the force of the spring factor compelling the third element to be moved from its position of repose to a position of tangential relationship to said circle, the third element in its position of tangential relationship to the circle being positively restrained by said actuator from movement toward its position of repose.

2. A device as defined in claim 1 wherein said actuator is a longitudinally movable wedge-shaped body positioned in a space between the third support element and an inclined plane portion of the headstock whereby during longitudinal movement in one direction of the actuator a transverse movement is interposed thereto in direction of the third support element contacting the same and compelling it to move away from its position of repose.

3. A device as defined in claim 2 further comprising a slide for moving said actuator biasing means for normally biasing the slide to place actuator out of operative position and thereby allowing the third element to assume

its position of repose, fluid power means for overcoming the biasing means and moving the actuator into its operable position, stop means on the headstock for limiting the movement of the actuator and defining the operable position of the third element in tangential relationship to said circle, and resilient means connecting the slide and the actuator whereby said actuator in operable position is longitudinally movable solely under the influence of said resilient means.

4. A device as defined in claim 2 further comprising a spring normally biasing the wedge-shaped actuator to an operable position, a fluid power motor cooperating with said actuator to over-ride said spring, latch means carried by said actuator for latching said third element in its position of repose, and means for unlatching said third element and thereby allowing said spring biased actuator to force said third element into operative position.

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