

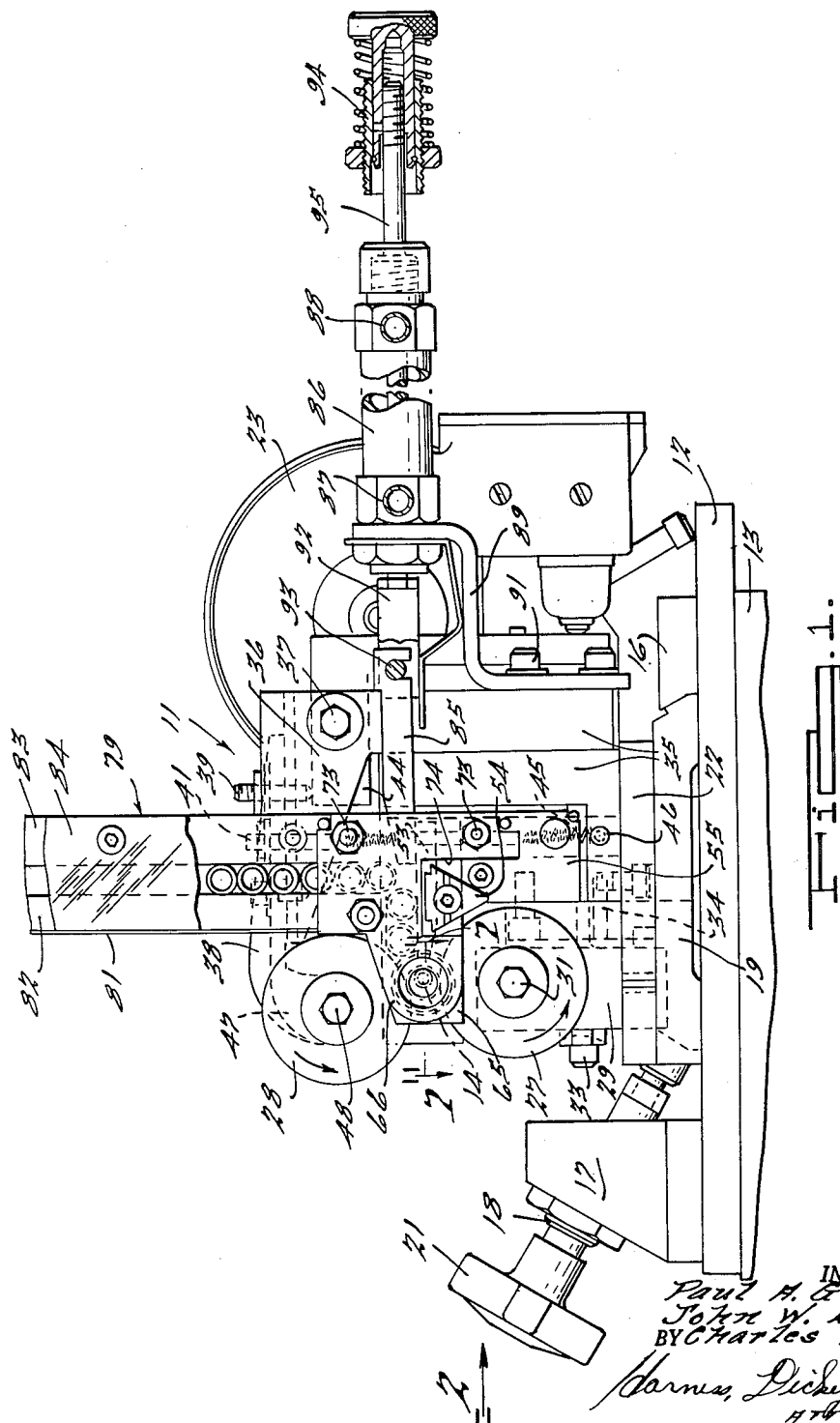
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P. A. GROBEY ETAL
GRINDING APPARATUS

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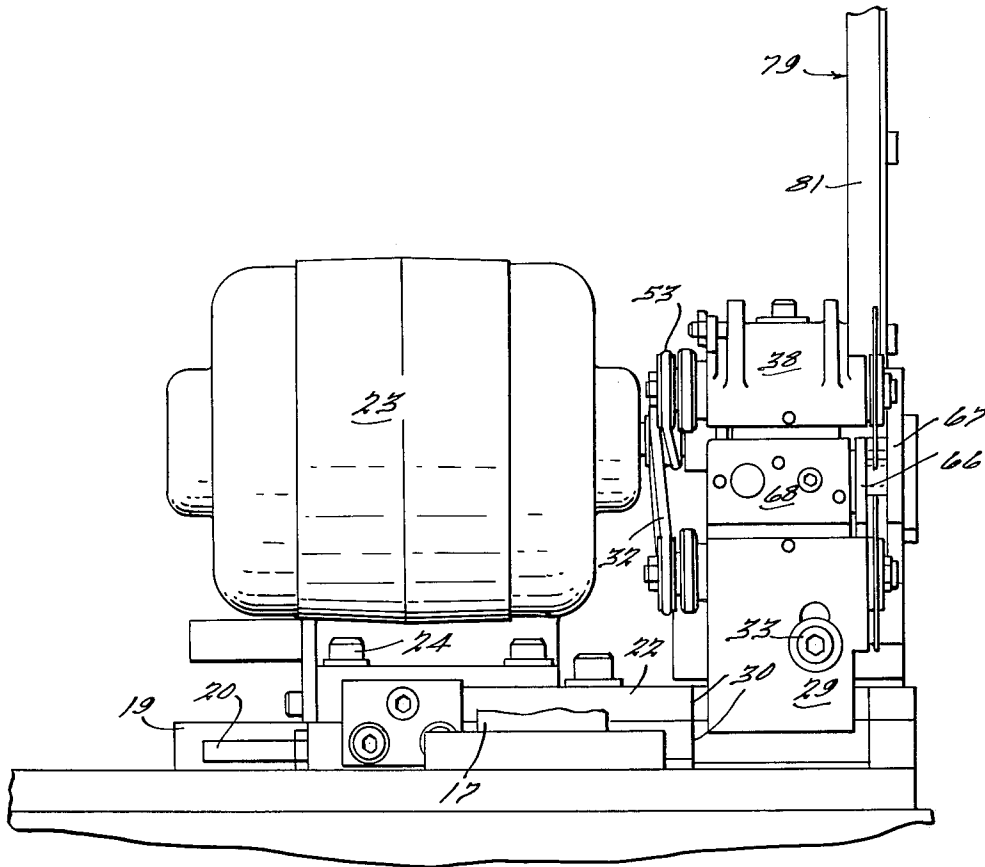


FIG. 2.

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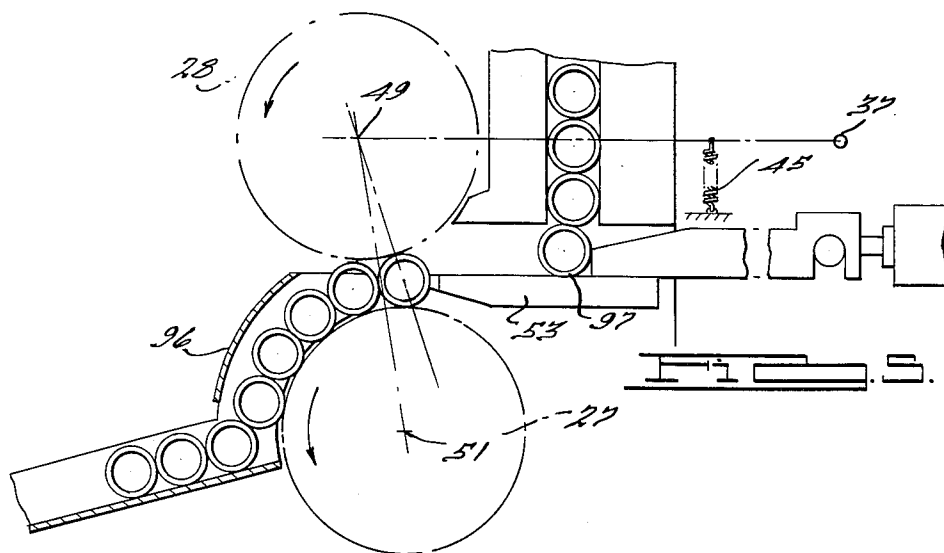
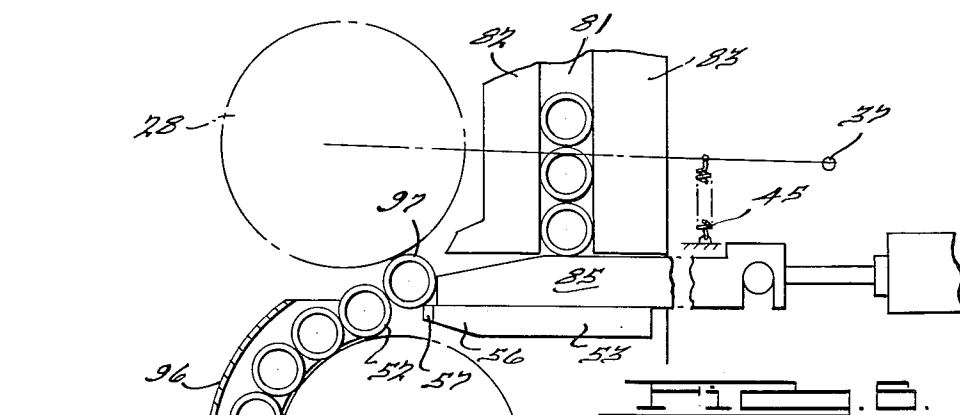
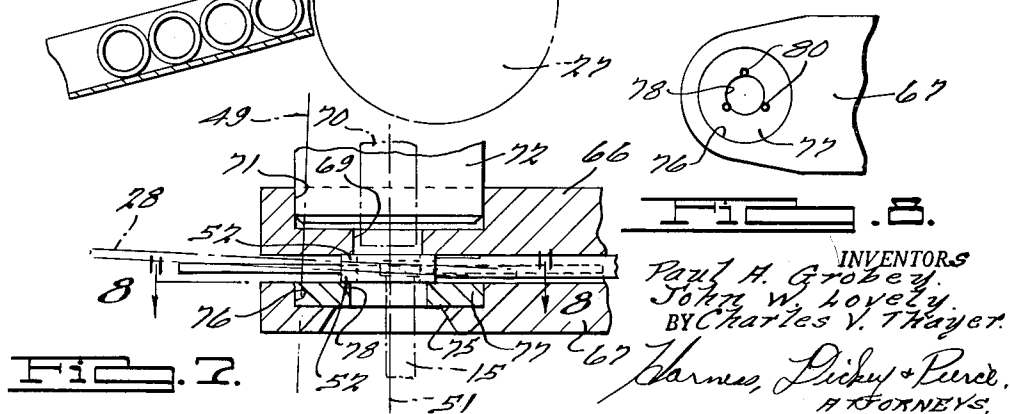
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GRINDING APPARATUS

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This invention relates to grinding apparatus, and more particularly to fixtures for use in conjunction with centerless internal grinders of the type used in finishing parts such as the races of miniature ball bearings.

It is an object of this invention to provide a novel and improved fixture for locating and driving workpieces to be internally centerless ground, which minimizes the chances of grinding inaccuracy, thus permitting the creation of precisely finished internal surfaces, especially on small workpieces.

It is another object to provide an improved grinding fixture of this nature which is especially adapted for rapid and high quantity production in automatic machines, and which will prevent the possibility of finished workpieces which have been discharged from the fixture from interfering with the grinding operation.

It is also an object to provide an improved grinding fixture of the above character in which means are inherently incorporated in the workpiece driving elements for assuring that the workpiece is positively located at all times with respect to the grinding tool, and which minimizes the possibility of any slight malformations in the workpiece driving element from affecting the workpiece position during grinding.

It is a further object to provide a novel and improved grinding apparatus of the above nature which is adapted for use in conjunction with a thrust gauge plug, and permits quick interchangeability with another similar fixture in the grinding machine assembly when the size of the workpieces is being changed.

Other objects and features of novelty of the invention will be specifically pointed out or otherwise become apparent when referring, for a better understanding of the invention, to the following description taken in conjunction with the accompanying drawings wherein:

FIGURE 1 is a side elevational view of a grinding fixture constructed according to the principles of the invention and showing the relative locations of the main components;

FIGURE 2 is an end elevational view taken in the direction of the arrow 2 of FIGURE 1 and showing the adjustable lower driving disc support;

FIGURE 3 is a top plan view of the fixture showing the driving connection between the motor and the driving discs as well as the adjustable nature of the upper driving disc supporting arm;

FIGURE 4 is a schematic view showing a workpiece in position against the abutment and between the driving discs, and illustrating the relative locations of the disc and workpiece centers;

FIGURE 5 is a view similar to FIGURE 4 showing the loading blade in a retracted position;

FIGURE 6 is a view similar to FIGURES 4 and 5 and showing the loading blade in a partially advanced position urging the next workpiece between the driving discs;

FIGURE 7 is a partially schematic cross-sectional view taken along the line 7—7 of FIGURE 1 and showing the slight relative angularity between the axes of the two driving discs as well as the location of the backing ring and its supporting plate; and

FIGURE 8 is a fragmentary elevational view taken along the line 8—8 of FIGURE 7 and showing the diamond inserts in the backing ring.

In general terms, the illustrated embodiment of the

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invention comprises a rectangular base adapted to be mounted adjacent a grinding machine having a spindle for grinding the internal surfaces of objects such as bearing races, the spindle having means for movements in directions parallel to and normal to the spindle axis. The fixture comprises a vertical chute adapted to carry the workpieces, a reciprocable loading blade below the chute, and combined locating and driving means laterally adjacent the chute for receiving the workpiece therein. This last-mentioned means includes upper and lower driving discs adapted to engage the peripheral surface of the workpiece, the discs being rotatably driven in the same direction to rotate the workpiece by frictional contact. The lower disc is on an adjustably fixed rotary axis while the other disc is rotatably mounted at the outer end of a pivoted arm which is urged toward the lower disc. A stationary stop or abutment is positioned laterally adjacent the peripheral surface of the workpiece and is engaged thereby during operation, the contact line of the workpiece with this abutment being substantially aligned with the workpiece and spindle axes in a horizontal plane. The contact line of the workpiece with the lower driving disc and the workpiece axis form a substantially vertical plane, thus minimizing the effect of any inaccuracy in the lower driving disc diameter on the grinding operation. The location of the upper driving disc axis is such that a line connecting the axes of the upper and lower discs will lie on a chord passing through the workpiece being ground, thus preventing the possibility of a discharged workpiece from being caught between the discs.

A line passing through the axes of the upper disc and workpiece will pass between the contact portions of the workpiece with the abutment and lower disc, thus assuring firm contact of the workpiece with the abutment and disc. The workpiece is disposed between two lateral plates, one of which is provided with an antifriction insert ring. The axes of the driving discs approach parallelism with the workpiece axis, each deviating from said parallelism in a direction and to the degree necessary to provide a force which will constantly urge the workpiece against the insert.

Referring more particularly to the drawings, the novel grinding fixture is generally indicated at 11 and comprises a base 12 of generally rectangular shape adapted to be mounted on a table 13 which also supports other components (not shown) of a centerless internal grinder. While the details of such components are not pertinent to the understanding of the present invention, it may be stated that the assembly includes means for supporting, driving and feeding a grinding wheel shown in dot-dash lines at 14 in FIGURES 1 and 4 which is supported by a spindle shown in dot-dash lines at 15 in FIGURE 3. The grinding machine components also include means for feeding grinding wheel 14 to the right as seen in FIGURE 1 into the bore or other internal surface of the workpiece, and also for feeding the grinding wheel across such surface in the direction of the grinding wheel axis.

Base 12 is provided with an elongated locating member 16 adjacent one edge thereof and a bracket 17 adjacent the other edge, the bracket carrying a clamp screw 18 for clamping a mounting plate 19 into position against member 16. Mounting plate 19 may be adjustably positioned to the left or right as seen in FIGURE 2 before being locked in place by clamping screw 18. A rod 20 is carried by plate 19 for co-operation with an indicator (not shown) carried by base 12 for accurately positioning fixture 11. It will be noted that the fixture may be quickly and easily removed by rotation of a handle 21 attached to clamping screw 18 so that it may be replaced by another fixture set up for a different size of workpiece.

Mounting plate 19 carries a platform 22 on which is mounted a variable speed electric motor 23, the motor

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being secured to platform 22 by bolts 24 passing through slots 25 in a motor base 26. The axis of the motor shaft is substantially parallel to the axis of grinding wheel 14, the motor being adjacent the same end of base 12 as locating member 16. Motor 23 is adapted to drive a lower workpiece driving disc 27 and an upper driving disc 28. Lower disc 27 is rotatably supported by a block 29, the lower end of which is disposed in notched portions 30 of base 19 and mounting plate 22 at the ends thereof adjacent bracket 16. Disc 27 is secured to a shaft 31 rotatably supported at the upper end of block 29 on an axis approaching parallelism with the axis of grinding wheel 14 as described above. Motor 23 drives an endless belt 32 connected to the inner end of this shaft. Block 29 is adjustable in a vertical direction and is clamped by means of a cap screw 33 passing through a slotted portion of the block and threaded into an upstanding stationary member 34 immediately behind the block, as seen in FIGURE 1. The diameter of disc 27 is such that its upper portion will extend beyond the upper surface of block 29. The disc is relatively thin, having flat parallel surfaces on both sides and a cylindrical edge surface engageable with the finished outside surface of a metal workpiece such as a bearing race. The material and finish of disc 27 is such that when rotated in contact with such a workpiece which is relatively unrestrained against rotation, the workpiece will be caused to rotate through frictional contact.

An upright member 35 is mounted on platform 22 at the portion thereof adjacent locating member 16. Upright member 35, which may comprise a plurality of joined elements, is of irregular configuration but has a wall portion extending from left to right in FIGURE 1 and an end portion extending from left to right in FIGURE 3, thus having a somewhat L-shaped configuration when viewed from above. An arm 36 is rockably mounted at 37 on the upper end of this upright member on an axis approaching parallelism with the grinding wheel axis as described above. Arm 36 extends toward the grinding location, and an adjusting arm 38 is secured thereto by bolts 39, 41 and 42, as seen in FIGURE 3. These bolts extend through an elongated slot 43 in arm 38 so that this arm may be adjusted in a longitudinal direction with respect to arm 36. Bolt 39 also acts as an adjustable stop cooperating with an abutment 44 extending from the upper end of member 35 in the direction of arms 36 and 38, as seen in FIGURE 1. A helical tension spring 45 is secured to the lower end of bolt 41, the lower end of the spring being attached to a stationary element 46 so that the spring urges arms 36 and 38 in a downward direction about pivot 37. The outer end of arm 38 is curved downwardly, as indicated at 47 in FIGURE 1, and driving disc 28 is rotatably supported thereon by a shaft 48. Disc 28 is of a construction similar to that of disc 27 and is disposed above and slightly to the left of the lower driving disc as seen in FIGURE 1 for the purposes which will appear below. The two discs are approximately in alignment, but the axis of at least one disc is angularly shifted from parallelism with the grinding wheel axis. This may be seen most clearly with respect to partially schematic FIGURE 7 in which it is apparent that the axis 49 of disc 28 is shifted slightly clockwise with respect to axis 51 of disc 27, the latter being directly below the workpiece axis as will appear below. The angular shifting shown in FIGURE 7 may be slightly exaggerated for purposes of clarity, but it will be noted that with this arrangement rotation of disc 28 in a counterclockwise direction as seen in FIGURE 1 would result in urging workpiece 52 toward lateral plate 67 as seen in FIGURE 7. Shaft 48 of disc 28 is driven by motor 23 through an endless belt 50 as seen in FIGURE 2. The driving arrangement is such that both discs 27 and 28 will rotate counterclockwise as seen in FIGURE 1, thus producing a clockwise rotation of workpiece 52.

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An abutment member 53 in the form of an elongated bar of rectangular cross-sectional shape is carried by upright member 35 adjacent the space between the driving discs 27 and 28. The abutment is supported by a plate 54 seen in FIGURE 1 which is adjustably secured to a block 55 mounted on upright member 35. The shape and relative position of abutment 53 may be best ascertained by reference to schematic FIGURES 4 to 6. End 56 of the abutment adjacent the space between discs 27 and 28 is tapered and carries a tip 57 of relatively hard-wearing and low friction properties such as a carbide insert. The surface of this insert facing the space between the discs is so positioned that the central portion 58 of the mutually contacting surfaces of workpiece 52 and abutment 53 will be parallel to axis 59 of workpiece 52 and in a substantially horizontal plane therewith. Axis 51 of driving disc 27 which also approaches parallelism with axis 59 as described above is in a substantially vertical plane therewith. The position of axis 49 of upper driving disc 28 is so adjusted that a line 61 connecting the axes 49 and 51 of discs 28 and 27 respectively will lie on a chord intersecting workpiece 52; that is, as seen in FIGURE 4, the arrangement will be such that should any workpiece 62 which has been discharged from its grinding position be held adjacent a workpiece 52 being ground, driving disc 28 will be unable to engage the discharged workpiece. Furthermore, the position of axis 49 of upper driving disc 28 will be such that a line 63 connecting axis 49 of disc 28 with contact line 64 of disc 28 with workpiece 52, if extended, will pass between contact portion 58 and contact line 65 of workpiece 52 with disc 27. The downward pressure of disc 28 will thus urge workpiece 52 between disc 27 and abutment 53, insuring contact of the workpiece with the abutment at all times.

Means are provided for guiding the workpiece into its position for grinding and preventing lateral movement thereof during grinding, this means including an inner guide plate 66 and an outer guide plate 67 in spaced parallel relation. Guide 66 is secured to a stationary element 68 which extends from the upper portion of upright member 35 between block 29 and arm 38, as seen in FIGURE 2. Plate 66 may be provided with a clearance aperture 69 seen in FIGURE 7 for a plug gauge 70 and a larger counterbore 71 for a pilot bushing 72 carried within member 68.

Outer guide plate 67 is secured to block 55 by bolts 73, this plate having a recessed portion 74 in its lower end for accommodating adjusting plate 54. As seen best in FIGURE 7, the outer end of plate 67 has a tapered access opening 75 for the reception of grinding wheel 14 and its spindle 15. Plate 67 is also provided with a counterbore 76 within which is disposed an insert 77 of a long wearing and low friction material such as a carbide. This insert has a clearance aperture 78 of smaller diameter than the opening 75 but greater than the inner diameter of workpiece 52. The outer annular surface of that side of workpiece 52 adjacent insert 77 will therefore be supported by the insert against lateral movement. The spacing between plates 66 and 67 will be sufficient to permit loading and unloading of workpieces without danger of jamming.

In order to increase the wearing properties of insert 77, a plurality of circumferentially spaced diamonds 80, three being shown, are carried by and bonded to the exposed surface of the insert adjacent its inner portion, the faces of these diamonds being lapped flat and parallel to the insert surface and being engageable by the workpiece.

FIGURE 7 also illustrates in partially schematic fashion the means for insuring that workpiece 52 will constantly be held against insert 77, thus preventing inadvertent lateral movement of the workpiece. In the present instance, at least one of the driving disc axes is shifted angularly from parallelism with the workpiece axis in a horizontal plane, as seen in FIGURE 7 and described

above. As illustrated, axis 49 of upper driving disc 28 is shifted slightly clockwise in FIGURE 7 from the axis 51 of driving disc 27 which is directly below and approaches parallelism with axis 59 of workpiece 52 as described above. Because of this fact, counterclockwise rotation of driving disc 28 in FIGURE 1 will impart a frictional force component to workpiece 52 urging the workpiece against insert 77 as seen in FIGURE 7. It will be understood of course that both driving discs 27 and 28 could be oriented so as to impart this axially directed frictional force component to workpiece 52 as described above.

Means are also provided for storing workpieces in position for loading into their grinding position, this means comprising a chute generally indicated at 79 and comprising a first upright plate 81 secured to upright member 35, a pair of spaced guide bars 82 and 83 secured to plate 81, and a cover plate 84 which may be of transparent material in order that workpieces may be visible within the chute. The lower ends of bars 82 and 83 are in spaced relation with the upper surface of abutment 53 so as to form a horizontally extending channel leading to the grinding location as seen in FIGURES 4 to 6. A loading blade 85 is slidably disposed within this channel and is reciprocable by an air operated motor 86 having fluid connections 87 and 88 at its opposite ends. This motor is supported by a bracket 89 secured by bolts 91 to upright member 35, and the motor piston has an extension 92 connected by a pin 93 with blade 85, as seen in FIGURE 1. A shock absorbing mechanism 94 may be provided at the opposite end 95 of the motor piston to reduce the shock when the motor reaches the end of its loading stroke.

Operation of the novel and improved grinding machine fixture may perhaps best be described with respect to schematic FIGURES 4, 5, and 6, which show the positions of the various parts during a grinding and loading cycle. Assuming initial conditions in which a workpiece 52 has been loaded into position, the parts will be located in the positions shown in FIGURE 4. Workpiece 52 will have dropped into position between driving discs 27 and 28 which will be driven counterclockwise by motor 23, causing clockwise rotation of the workpiece. FIGURES 4, 5, and 6 show a discharge chute 96 adjacent the grinding position for receiving the discharged workpieces, this chute being shown in a filled condition which might be the case during quantity production. As stated previously, a line 61 connecting axes 49 and 51 of the driving discs lies on a chord passing through workpiece 52 which is in grinding position against abutment 53. This geometrical arrangement will inherently prevent any workpiece 62 which may have been discharged from being gripped between driving discs 27 and 28 and thus interfering with the grinding operation.

During grinding, grinding wheel 14 will be fed radially (to the right in FIGURE 4) and will also be fed parallel to the workpiece axis into and out of the workpiece. The axis of grinding wheel 14 is on a substantially horizontal line connecting the axis of workpiece 52 and the contact portion 58 of the workpiece with abutment 53, while the axis 51 of driving disc 27 intersects a substantially vertical line passing through the workpiece axis. Any irregularities in the contour of driving disc 27 will thus not materially affect the controlled grinding depth of grinding wheel 14, since any movement of workpiece 52 created by such irregularities will be at substantially right angles to the direction of radial grinding wheel feed movement.

It will also be noted that, as previously described, line 63 connecting the axis of disc 28 and workpiece 52 respectively will pass between contacts 58 and 65 of the workpiece with abutment 53 and disc 27 respectively. This will serve to maintain the workpiece in constant engagement with the abutment and lower driving disc, preventing any movement of the workpiece which might re-

sult in grinding inaccuracy. The urging of workpiece 52 against lateral support member 77 will prevent lateral or end play of the workpiece, and the feeding of grinding wheel 14 normal to the spindle axis will thus result in an accurately formed ground surface.

After workpiece 52 has been ground, loading blade 85 will be retracted as seen in FIGURE 5, permitting a second workpiece 97 to drop into position ready for loading. Upon the next advancing movement of loading blade 85, workpiece 97 will be pushed along the upper surface of abutment 53, and as it engages driving disc 28 the latter will swing upwardly about pivot 37 as seen in FIGURE 6, until workpiece 97 drops into position in front of abutment 53. This action will cause workpiece 52 to be discharged into chute 96.

It will thus be seen that a grinding machine fixture has been provided which is not only adapted for high quantity production, but permits the attainment of highly accurate internally ground surfaces in small parts without the danger of errors created by unwanted shifting of the workpieces in radial or axial directions. The fixture is of relatively simple construction, requires little maintenance, and may be easily interchanged with other similar fixtures for grinding different sizes of pieces.

While it will be apparent that the preferred embodiment of the invention disclosed is well calculated to fulfill the objects above stated, it will be appreciated that the invention is susceptible to modification, variation and change without departing from the proper scope or fair meaning of the subjoined claims.

What is claimed is:

1. In a fixture for supporting and rotating annular workpieces to be internally ground by a grinding wheel,
 - (a) a stationary abutment adapted to be contacted by the external surface of a workpiece,
 - (b) a first disc rotatable on a stationary axis below said workpiece,
 - (c) said first disc axis, workpiece axis, and abutment contact positioned relative to each other such that the abutment contact and workpiece axis line is spaced approximately 90° from a line connecting the first disc axis with the workpiece axis,
 - (d) a second disc rotatably supported on a movable axis above said workpiece and on a vertical plane separate from the axis of said first disc,
 - (e) means for driving at least one of said discs in a direction to rotate the workpiece,
 - (f) the axis of at least one disc being angularly displaced from parallelism with the workpiece axis creating an axial force on the workpiece,
 - (g) and a stationary guide plate having an abutment surface for opposing said axial force of the workpiece,
 - (h) said guide plate abutment surface positioned adjacent the discs on the side of the workpiece the grinding wheel enters, and having an access opening for the reception of the grinding wheel to internally grind the workpiece.
2. In a fixture for supporting and rotating an annular workpiece to be internally ground by a grinding wheel,
 - (a) a stationary abutment adapted to be contacted by the external peripheral surface of a workpiece when in grinding position,
 - (b) a first rotatable disc engageable by said workpiece peripheral surface and having its horizontal axis below said abutment and on substantially the same vertical plane as the horizontal axis of said workpiece,
 - (c) a second rotatable disc engageable by said workpiece peripheral surface and having its horizontal axis on a movable support above said abutment,
 - (d) said second disc horizontal axis being on a separate vertical plane than the horizontal axis of said first disc to force the workpiece against the stationary abutment and first disc,

- (e) the axis of at least one disc being angularly displaced from parallelism with the workpiece axis to force the workpiece axially,
- (f) and first and second stationary guide plates in spaced parallel relation on opposite sides of the workpiece to assist in guiding the workpiece into grinding position and opposing axial movement of said workpiece while in grinding position,
- (g) one of said guide plates having an access opening for the reception of the grinding wheel to internally grind the workpiece.
3. In a fixture for supporting an annular workpiece to be internally ground,
- (a) a stationary abutment adapted to be engageable by a workpiece when in grinding position,
- (b) a first disc engageable by said workpiece and having its horizontal axis below said abutment and in substantially the same vertical plane as the horizontal axis of said workpiece,
- (c) a second disc engageable by said workpiece and having its horizontal axis on a movable support above said abutment, said support having means for urging said second disc downwardly,
- (d) said second disc horizontal axis being in a separate vertical plane than the horizontal axis of said first disc to force the workpiece against the stationary abutment and first disc,
- (e) the axis of at least one disc being angularly displaced from parallelism with the workpiece axis whereby an axial force will be exerted on the workpiece,
- (f) first and second stationary guide plates in spaced parallel relation on opposite sides of the workpiece and having sufficient spacing to assist in guiding the workpiece into and out of grinding position without danger of jamming,
- (g) said first guide plate having an abutment surface for opposing axial movement of said workpiece while in grinding position, the abutment surface having an access opening for the reception of a grinding wheel,
- (h) said second guide plate having an access opening for the reception of a plug gauge to gauge the workpiece while in grinding position, said first guide plate resisting axial movement of said workpiece when engaged by said plug gauge.
4. In a fixture for supporting and rotating an annular workpiece to be internally ground by a grinding wheel,
- (a) a stationary abutment adapted to be contacted by a workpiece peripheral surface when in grinding position,
- (b) a first rotatable disc engageable by said workpiece

- peripheral surface and having its horizontal axis below said abutment,
- (c) a second rotatable disc engageable by said workpiece peripheral surface and having its horizontal axis on a movable support above said abutment,
- (d) said second disc horizontal axis being in a separate vertical plane than the horizontal axis of said first disc to force the workpiece against the stationary abutment and first disc,
- (e) a loading chute on one side of said discs for holding workpieces,
- (f) a reciprocable loading member movable between a retracted position for receiving a workpiece from said chute and an extended position moving such workpiece into grinding position by moving said second disc,
- (g) and a discharge chute on the other side of said discs for receiving discharged workpieces from the grinding position,
- (h) the relative position of said discs and abutment being such that a workpiece in grinding position will maintain said second disc spaced from a discharged workpiece permitting said discharged workpiece to pass into the discharge chute,
- (i) the axis of at least one disc being angularly displaced from parallelism with the workpiece axis whereby an axial force will be exerted on the workpiece,
- (j) first and second stationary guide plates in spaced parallel relation on opposite sides of the workpiece grinding position and having sufficient spacing to assist in guiding the workpiece into and out of grinding position without danger of jamming and resisting axial movement of the workpiece,
- (k) one said guide plate having an access opening for the reception of a grinding wheel to internally grind the workpiece.

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