March 8, 1960 C. J. TERP 2,927,406

WORK LOADING AND SUPPORTING DEVICE FOR AN INTERNAL GRINDING MACHINE

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Fig. 1.

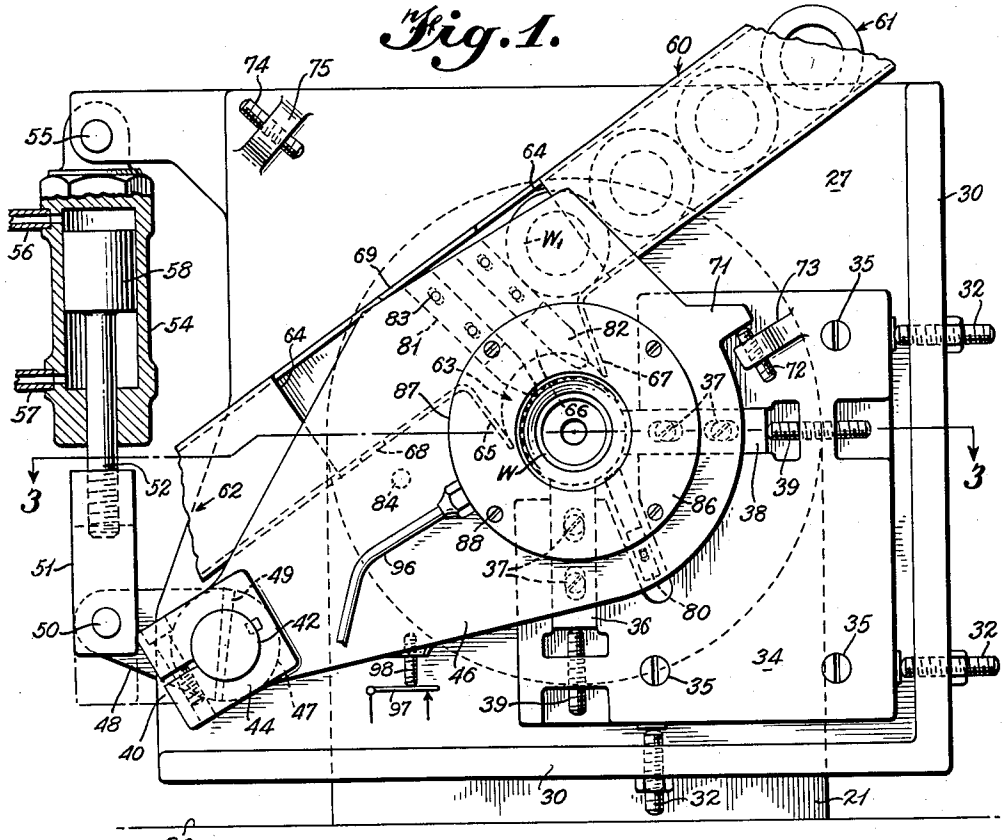
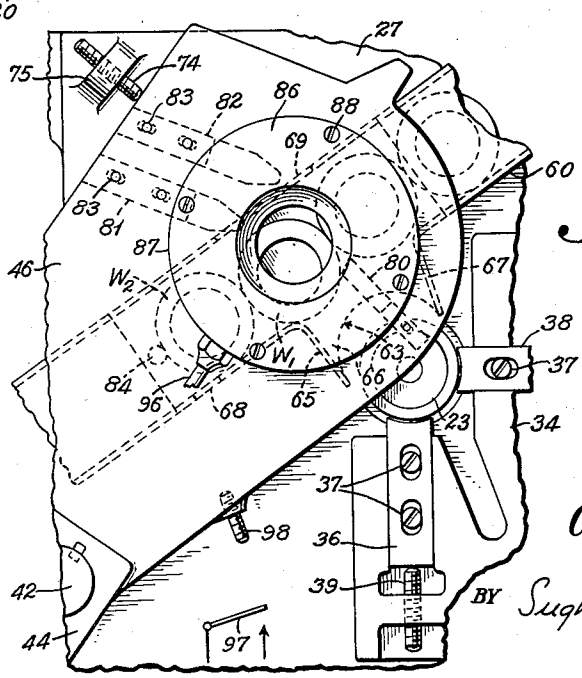


Fig. 2.



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Fig. 3.

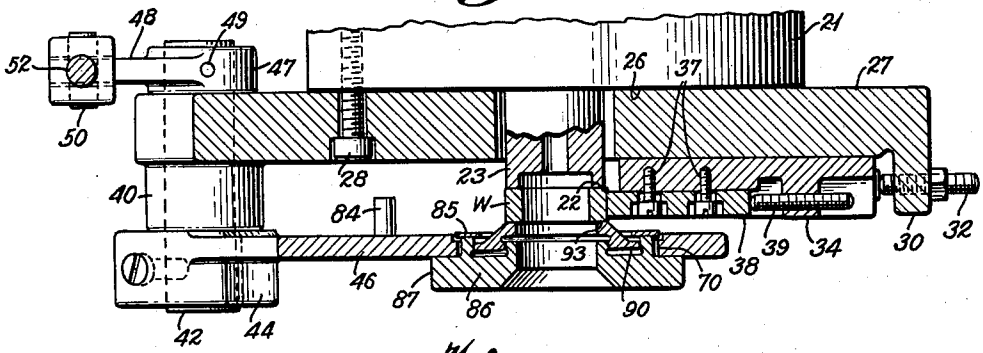


Fig. 4.

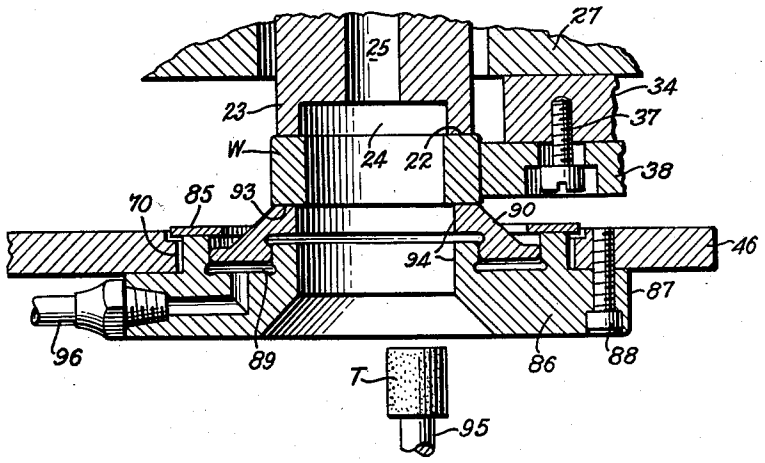
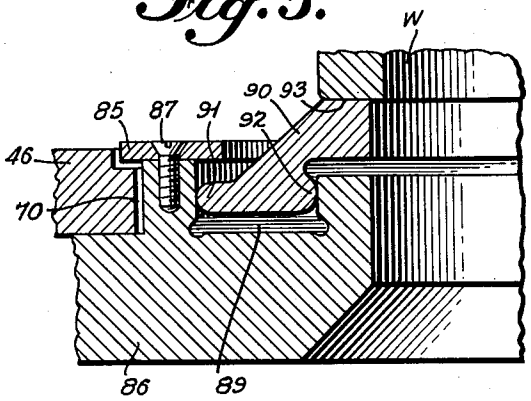


Fig. 5.



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Fig. 6.

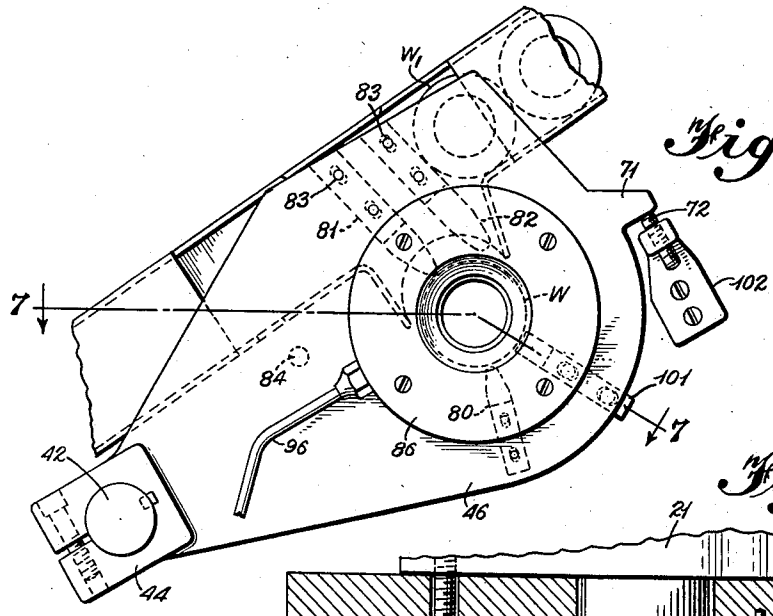


Fig. 7.

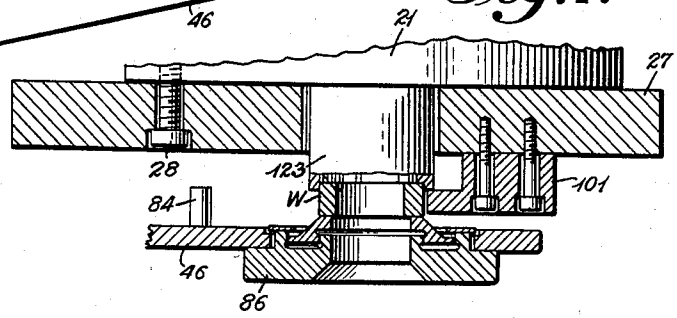


Fig. 8.

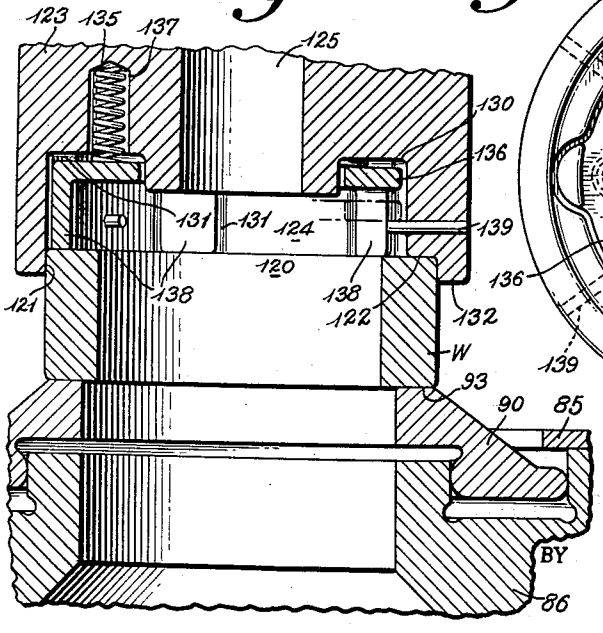
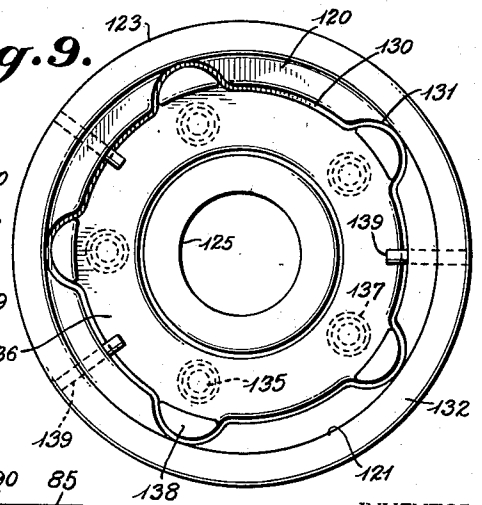


Fig. 9.



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2,927,406

WORK LOADING AND SUPPORTING DEVICE FOR AN INTERNAL GRINDING MACHINE

Charles J. Terp, Springfield, Vt., assignor to Bryant Chucking Grinder Company

Application July 9, 1957, Serial No. 670,698

18 Claims. (Cl. 51—103)

This invention relates to improvements in internal grinding machines of the type wherein an annular workpiece is radially supported on its preformed outside surface and is axially supported and clamped against a work driver end face which is normal to the axis of a rotatable headstock spindle, and a tool is applied to its internal surface to generate a hole concentric with the preformed outside surface. More particularly this invention relates to a work loading and supporting device for an internal grinding machine of the type disclosed in the U.S. patent to Arms et al. No. 2,635,395.

In automatic grinding machines it is important that the loading and unloading of the workpieces be executed with precision at a high rate of speed. Several ingenious devices have been previously suggested and used, however, these prior devices are complicated in design, cumbersome in operation, and demand a relatively large amount of axial space, which is usually at a premium.

It is therefore an object of this invention to provide an automatic loader of simplified design.

Another object is to provide a loader in combination with axial work clamping means in a unitary structure.

For a more complete understanding of this invention, reference may be had to the following detailed description taken in connection with the accompanying drawings, wherein:

Figure 1 is an elevational view with a portion in section illustrating a preferred embodiment with the operative elements in grinding position;

Figure 2 is a fragmental view similar to Figure 1 with the operative elements displaced away from the grinding position to the loading position;

Figure 3 is a sectional view along line 3—3 of Figure 1;

Figure 4 is an enlarged view of a portion of Figure 3;

Figure 5 is a still more enlarged detail view of a portion of Figure 4;

Figure 6 is a partial elevation similar to Figure 1 illustrating a variation from the preferred embodiment;

Figure 7 is a sectional view taken along line 7—7 of Figure 6;

Figure 8 is an enlarged detail view of a part of Figure 7;

Figure 9 is an elevation of Figure 8.

Referring to Figures 1 and 3, there is shown a surface 20 of a machine bed to which is attached a headstock housing 21 containing a rotatable spindle having an exchangeable end portion 23 with a face 22 normal to the spindle axis. This face axially supports an annular workpiece W held in frictional relationship thereto and compels the workpiece to rotate while at the same time seating the workpiece against radial support shoes in a manner described in Patent No. 2,365,395 referred to above. In the portion 23 of the headstock spindle there is a circular recess 24, and a hole 25 is provided through the spindle for access of various auxiliary devices such as coolant conduit, gaging means, etc.

A bracket 27 is attached to the front face of the headstock housing by several screws 28. In flange portions 30 of the bracket 27 are setscrews 32 for adjusting the

position of a plate 34 which, after adjustment, is clamped against the bracket 27 by several screws 35. Radial workpiece supporting shoes 36 and 38 are guided in slots in the plate 34 and are radially adjustable by setscrews 39 also threaded in the plate 34. After adjustment the support shoes may be fixedly secured to the plate by suitable means such as screws 37 threaded into the plate and extending through slots in the shoes.

Integral with the bracket 27 is a cylindrical bearing portion 40 in which a shaft 42 is journaled. A hub 44 of a loader arm 46 is rigidly attached to the shaft 42 at one end thereof, and at the other end thereof a hub 47 of an operating arm 48 is secured by suitable means such as dowel 49. The arm 48 is pivotly connected by a swivel pin 50 to a forked shaped yoke 51 thereby coupling the shaft 42 to a piston rod 52 of a fluid power motor 54. This motor is hinged at 55 to the bracket 27. The cylinder of the motor may be supplied with a pressurized fluid alternately through conduits 56 and 57 to opposite ends of the working piston 58.

A workpiece chute 60 is supported on the bracket 27 by suitable means and is inclined to feed the workpieces by gravity to the grinding location. The chute is of closed rectangular cross section, and has openings in the ends for ingress of workpieces at 61 from a hopper and egress of finished workpieces at 62 plus an access opening 63 at the grinding location. The front side of the chute as viewed in Figure 1 also has a portion between edges 64—64 removed. This portion is, however, always covered by a portion of the loader arm 46. The access opening 63 is surrounded on three sides by wall portions 65, 66 and 67. There are further access cutouts 68 and 69 in the top and bottom walls of the chute.

The loader arm 46 has the general form of a plate which is integral with the hub 44 and this plate has a bore 70 which, in the position shown in Figure 1, is substantially concentric to the axis of the headstock spindle. This position is fixed when a lug 71 depending from arm 46 abuts an adjustable stop 72 threaded in a lug 73 depending from plate 34. In the loading position of the arm shown in Figure 2, bore 70 has its axis near the center of the chute when an edge of the arm 46 abuts against an adjustable stop 74 threaded in a lug 75 depending from the bracket 27. Pusher elements 80 and 81, together with a divider element 82, are adjustably attached on the face of the arm 46 which is adjacent the headstock. These elements are so positioned that their inner ends are outside and adjacent a circle defined by the outside periphery of the workpiece W. The means for adjustably securing these elements comprises screws 83 which extends through slots in the elements and are threaded into the face of the arm 46. From the same face of the arm 46 facing the headstock, a pin 84 extends inwardly toward the chute to act as a stop for the workpieces in the chute when the arm 46 is in loading position as shown in Figure 2. The access cutouts 68, 69 in the bottom and top walls of the chute provide passages for elements 81, 83 and 84 when passing from the grinding position of Figure 1 to the loading position of Figure 2.

As shown in Figures 3 and 4, an interchangeable cartridge 86 is nested in the bore 70 and a flanged portion 87 of this cartridge is secured to the front face of arm 46 by screws 88. This cartridge constitutes the cylinder portion 89 of a fluid power axial clamp for clamping the workpiece, and this cylinder is shaped as an annular channel which is open towards the headstock. An annular free piston 90 is contained within the cylinder and this piston has crowned outer and inner peripheries 91 and 92 respectively, as best shown in Figure 5. This configuration allows the piston to be slightly tilted while still presenting a minimal path for fluid leakage. The piston has a face portion 93 directed towards the face 22

of the headstock spindle. The cartridge and the piston have central circular apertures 94 forming access for a tool T mounted on a rotatable spindle 95. A relative transverse feed movement may be imparted between the tool and the headstock when the tool is placed axially in the grinding zone as is well known in the art. A pressurized fluid medium may be supplied behind the piston 90 through conduit 96 from a suitable source for providing the power for the clamp. A retainer ring 85 is fastened by screws 87 at the open end of cylinder 89 to prevent the piston 90 from being displaced out of the cylinder.

A normally open switch 97 as indicated in Figure 2 is held closed when an adjustable stop 98 threaded in arm 46 abuts the switch lever as illustrated in Figure 1. This switch performs a safety function in that it is closed only when the loader arm is in grinding position and it is open when the loader arm is in the loading position.

In Figures 6 through 9 a variation of described embodiment is illustrated. The bracket 27, the loader arm 46, and the operating mechanism and auxiliaries therefore are as previously described. However, the plate 34 including the radial workpiece supports is removed and adjustable stop 72 is threaded in an element 102 bolted to the bracket 27. A dummy-shoe 101 is also adjustably fixed to the bracket and is adjusted so that its inner end will be located substantially on the periphery of the circle as defined by elements 80, 81 and 82, indicated in Figure 6. An interchangeable portion 123 of the headstock spindle, Figures 7 and 8, has in its outer extreme face 132 a recess formed as a shallow pot 120 for supporting the workpiece W radially by a circular wall 121 co-axial to the axis of the headstock spindle and supporting the workpiece axially by a plane 122 formed by a shoulder portion between the wall 121 and the bore of a clearance recess 124. An access hole 125 may be provided for communication with a bore of the headstock spindle. In the bottom of the recess 124 there is formed a still deeper annular recess 130 into which opens several pockets 131 extending axially from the plane 122 to the bottom of the recess 130. These pockets are circumferentially spaced as shown in Figure 9. A generally ring shaped element 136 positioned in recess 130 is provided with fingers 138 extending outwardly through the pockets 131 as shown in Figures 8 and 9. A plurality of compression springs 135 are positioned within holes 137 with their ends abutting against the bottom of the holes and ring element 136 thus normally biasing this element to an outward position established by stop pins 139. These stop pins protrude into recess 124 and are positioned to stop the ring element 136 when extreme ends of fingers 138 are approximately flush with the face 132.

The operation of the device is as follows: In the position of Figures 1 and 3 a workpiece is radially supported on shoes 36 and 38 and is axially clamped between faces 22 and 93 when the pressurized medium is supplied through the conduit 96 behind the piston 90. In this position divider 82 prevents the workpiece W_1 from rolling down the chute. After finishing the grinding of a workpiece, the pressure is relieved from the cylinder 89 and the motor 54 is supplied with pressure through conduit 56 while exhausting through conduit 57. This forces the piston 58 downwards swinging the arm 46 to the position of Figure 2 abutting stop 74. The pusher 80 will then carry along the finished workpiece W_2 to the chute where it will roll downwards until it is stopped by pin 84, now in the chute path, and as divider 82 no longer blocks this path an unfinished workpiece W_1 is permitted to roll down and lodge between workpiece W_2 and pusher 80. The fluid flow in the servo motor cylinder is now reversed and the pressure supplied through conduit 57 returns the piston 58 to its upper position to carry the arm 46 to the position of Figure 1 and the pusher 81 pushes the lodged workpiece to the grinding position, whereafter pressure is again supplied behind piston 90 through conduit 96 thereby clamping the workpiece W_1 as described above. In the downward movement divider 82 again blocks the workpieces from the ingress end 61 of the chute while pin 84 is moved out of the path of the chute and the workpiece W_2 is allowed to roll out through the egress opening 62. The normally open switch 97 acts as an interlock to prevent clamping and further operation of the machine before arm 46 is properly positioned against adjusted stop 72.

The operating sequence of the loader arm in the modification illustrated in Figures 6 through 9 is in general like that described above. In this modification however the radial dummy-shoe 101 acts as a safeguard to assure that the workpiece will be located approximately in a centralized position in front of pot 120 to permit piston 90 to move the workpiece into the pot and clamp it between faces 93 and 122. The inner face of the workpiece will, during this movement, abut the fingers 138 and carry the ring 136 inwards against the force of springs 135. When the pressure behind piston 90 is later removed the springs 135 force the fingers 138 to eject the workpiece from the pot 120 and the workpiece is then discharged as another workpiece is loaded by the action of elements 80, 81 and 82 as described above.

Applicant has disclosed a simple and effective combination of a loading and axial clamping device having a minimum of operative elements that is capable of executing its functions with precision and speed. It should be clear to a mechanic having ordinary skill in the art that potential modifications are possible in the described embodiments which are merely illustrative and not limiting, as the invention is limited only by the scope of the appended claims, wherein applicant is entitled to the full range of equivalents.

What is claimed is:

1. In an internal grinding machine of the type wherein an annular workpiece is radially supported on a preformed periphery in frictional relationship to angularly spaced fixed supports, and an end face of the workpiece is axially located and held in frictional relationship with a rotatable workdriving surface normal to the axis of a headstock spindle; in combination with a work loading and clamping device comprising: a loader arm movable, in a plane substantially normal to the axis of the headstock spindle between a plurality of positions, stops positively limiting the movement and fixing the position of the arm in the separate positions, movable work clamping means for forcing said workpiece against the workdriving surface of the headstock spindle, said work clamping means being mounted on the arm movable axially toward the workdriving surface of the headstock spindle and positioned adjacent the workpiece driving surface of the headstock spindle whilst the arm is in one of the positions, and means for moving the arm to sustain a force to hold it against the stops.

2. A device as defined in claim 1 further comprising: a workpiece delivery chute having openings therein for the ingress and egress of workpieces and for delivery of workpieces to a grinding position, and wherein one of the other positions of the loader arm places the workpiece clamping means adjacent the delivery chute, also wherein the clamping device is a ring shaped fluid pressure cylinder, containing therein a free piston having an annular face directed towards the workdriver surface of the headstock spindle to engage the other end face of the workpiece; means for supplying a pressurized fluid to the cylinder behind the piston for urging the same to move toward the workdriver surface whilst the arm is in the position wherein the work clamping means is adjacent the workdriving surface, also wherein the side of the arm facing the headstock carries adjustably fixed first and second pusher elements, and a divider element, which elements together form said support means for confining a workpiece during movement of the arm, these elements being arranged angularly outside and adjacent the pe-

riphery of a circle, defined by the radial work supporting elements.

3. A device as defined in claim 2 wherein the divider forms a barrier blocking the ingress side of the delivery chute when the arm is in a work clamping position, and a pin element on the same side of the arm forms a barrier blocking the egress side of the chute when the arm is in a work loading position.

4. In an internal grinding machine of the class having a headstock containing a rotatable spindle with a surface thereon normal to the axis of the spindle which axially supports and drives a workpiece by an end face thereof; a device comprising: a shallow pot chuck the bottom thereof forming the driving surface, the chuck having a peripheral rim portion extending outwardly from the surface whereby an internal periphery of the rim defines the radial position of a preformed periphery on a workpiece, and this position is concentric to the axis of the spindle; a series of axially extending ejector fingers spaced angularly around the surface; spring means constantly urging the fingers outwardly to place the extremes of the fingers substantially flush with the extreme of said rim; a loader arm mounted to pivot about an axis parallel to the spindle axis; clamping means mounted on the arm remote from the pivot, this means having an annular clamping face to engage the other end face of the workpiece; a workpiece delivery chute attached to the machine and having a loading station; and means to impart a rocking movement to the shaft and arm, in a plane substantially parallel to the workdriving surface, from a position where the axis of the clamping face is co-linear with the spindle axis to another position where the axis of the clamping face is positioned at the loading station in the delivery chute.

5. A device as defined in claim 4 wherein the clamping means is a fluid power clamp comprising: a ring shaped fluid pressure cylinder containing a rotatable free piston therein on which is formed an annular clamping face directed towards the workdriver surface on the spindle; and means to supply a fluid pressure medium behind the piston to move it towards the workdriver surface for engaging a workpiece and holding the same in contact therewith against the spring force of the ejector fingers, this spring force acting through the intermediary of workpiece to force the piston in opposite direction in absence of supply of the pressure medium.

6. A device as defined in claim 5 having a radially adjustable dummy shoe with one end thereof in fixed relationship to the radial workpiece supporting periphery of the pot outside and adjacent thereto.

7. In an internal grinding machine of the class having a headstock with a rotatable spindle journaled therein, the spindle being provided at one extreme with a surface normal to its axis to axially support and rotatably drive an annular workpiece held with an end face in frictional relationship to the surface, a tool adapted to be applied in engagement with the interior of the workpiece to generate a surface concentric with a preformed surface of the workpiece; an axial workpiece clamping device comprising: a fluid cylinder having a piston therein to which pressurized fluid medium may be supplied to compel the piston to move towards the workdriving surface, this piston being provided with an annular clamping face which is axially spaced from and normally parallel to the workdriver surface for engaging another end face of the workpiece in frictional relationship; a loader arm carrying the cylinder and being rockable about a pivot for moving said clamping face between a first and a second position in a plane substantially parallel to said surface, in the first position the common axis of the clamping face and cylinder being substantially coaxial with the axis of the spindle; and a delivery chute having a loading station adjacent the axis of the annular clamping face when the arm is in the second position and means to move the arm between the first and second positions.

8. In a device as defined in claim 7, wherein said cylinder is ring-shaped with the walls parallel to its axis, and the mating portions of the piston are cambered with the chords thereof normal to the clamping face, and the crowns of the cambers form slidable and rotatable fits with the walls of the cylinder when the clamping face is normal to the axis of the cylinder, whereby with the clamping face tilted from said normal position only a minimal leakage path occurs between piston and cylinder walls.

9. In a device as defined in claim 8, wherein said cylinder and piston are provided with a central bore forming an access passage for the tool whilst the loader arm is in the first position.

10. In a device as defined in claim 9, wherein the loader arm on the side facing the surface on the work spindle is provided with elements circumferentially spaced about the cylinder axis with their inner ends radially spaced outside and adjacent a circle defined by the radial supporting means of a workpiece whilst the arm is in the first position.

11. In a device as defined in claim 10, wherein said elements define a cradle restrictively confining a workpiece therein during the movements of the arm between its two positions.

12. In a device as defined in claim 11, wherein one of said elements constitutes a barrier in the delivery chute blocking the ingress side thereof whilst the arm is in its first position, and a stop pin on the same side of the arm constitutes a barrier in the delivery chute blocking the egress side thereof whilst the arm is in the second position.

13. In a device as defined in claim 7, wherein the means for moving the arm provides a force against a stop means for the arm in the first and second positions, and a clamping force is applied by the piston in the first position only.

14. In an internal grinding machine: a headstock; a rotatable spindle contained in the headstock, the spindle having a work driving surface thereon normal to the spindle axis for axially supporting and driving an annular workpiece by an end face thereof; an annular recess in the driving end of the spindle, the bottom of the recess forming the normal driving surface and the side walls of the recess forming the radial support for the workpiece; means normally biasing a supported workpiece outwardly from the bottom of the recess; and a loader arm carrying power clamping means adapted to contact the other end face of an annular workpiece and to thereby clamp the two end faces of the workpiece between the driving surface on the spindle and contacting surface of the power clamping means.

15. A device as defined in claim 14 wherein the biasing means comprises: a ring member having extending fingers adapted to contact the end face of a supported workpiece; a plurality of springs contacting the ring to normally bias the ring outwardly; and a stop element for limiting the outward movement of the ring.

16. In an internal grinding machine having support means for supporting an annular workpiece on its preformed outer periphery, and a rotatable spindle with a work driving face normal to its axis, a work loading and clamping device comprising: a loader arm movable between at least two positions; work clamping means mounted on the arm and positioned adjacent the work driving face of the spindle for clamping the end faces of an annular workpiece between them when the arm is in one of the positions, the work clamping means comprising an annular channel shaped cylinder mounted on the arm with the open side of the channel facing the work driver, an annular piston with a workpiece contacting face contained in the cylinder, the piston having crowned portions where it is in contact with the cylinder wall, and means for supplying a pressurized fluid to

power the piston; and means to move the loader arm to each of the positions.

17. A device as defined in claim 16 further comprising a workpiece delivery chute having a loading station positioned adjacent the face of the loader arm when the arm is in one of the positions other than the position adjacent the face of the work driving spindle, and wherein the loader arm carries a divider element and a pair of pusher elements, the former in one position of the arm acting as a separating gate between workpieces in the chute and, together with the pusher elements, forms a cradle confining and restraining a workpiece during the movement of the arm between said positions.

18. In an internal grinding machine having support means for supporting an annular workpiece on its preformed outer periphery, and a rotatable spindle with a work driving face normal to its axis, a work loading and clamping device comprising: a loader arm movable between at least two positions; workpiece clamping means mounted on the arm and positioned adjacent the work driving face of the spindle for clamping the end faces of

an annular workpiece between them when the arm is in one of its two positions; means to move the loader arm to each of the positions; a workpiece delivery chute having a loading station positioned adjacent the face of the loader arm when the arm is in one of the positions other than the position adjacent the face of the work driving spindle; a divider element and a pair of pusher elements carried by the loader arm, the divider element and one position of the arm acting as a separating gate between workpieces in the chute and, together with the pushing elements, forming a cradle confining and restraining a workpiece during the movement of the arm between said positions.

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