Nov. 17, 1953 M. S. BURKHOLDER 2,659,186

RIDGE GRINDER FOR ENGINE CYLINDERS

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FIG 3

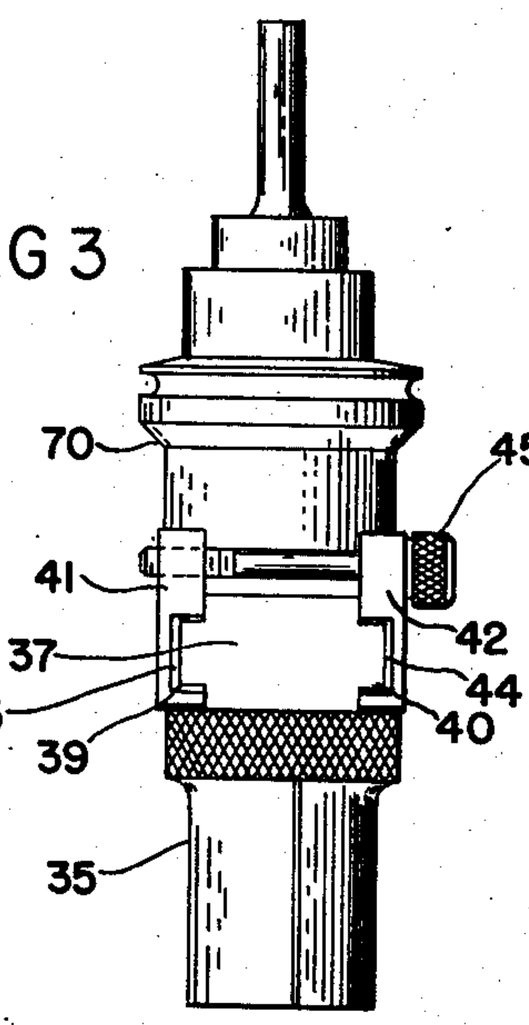
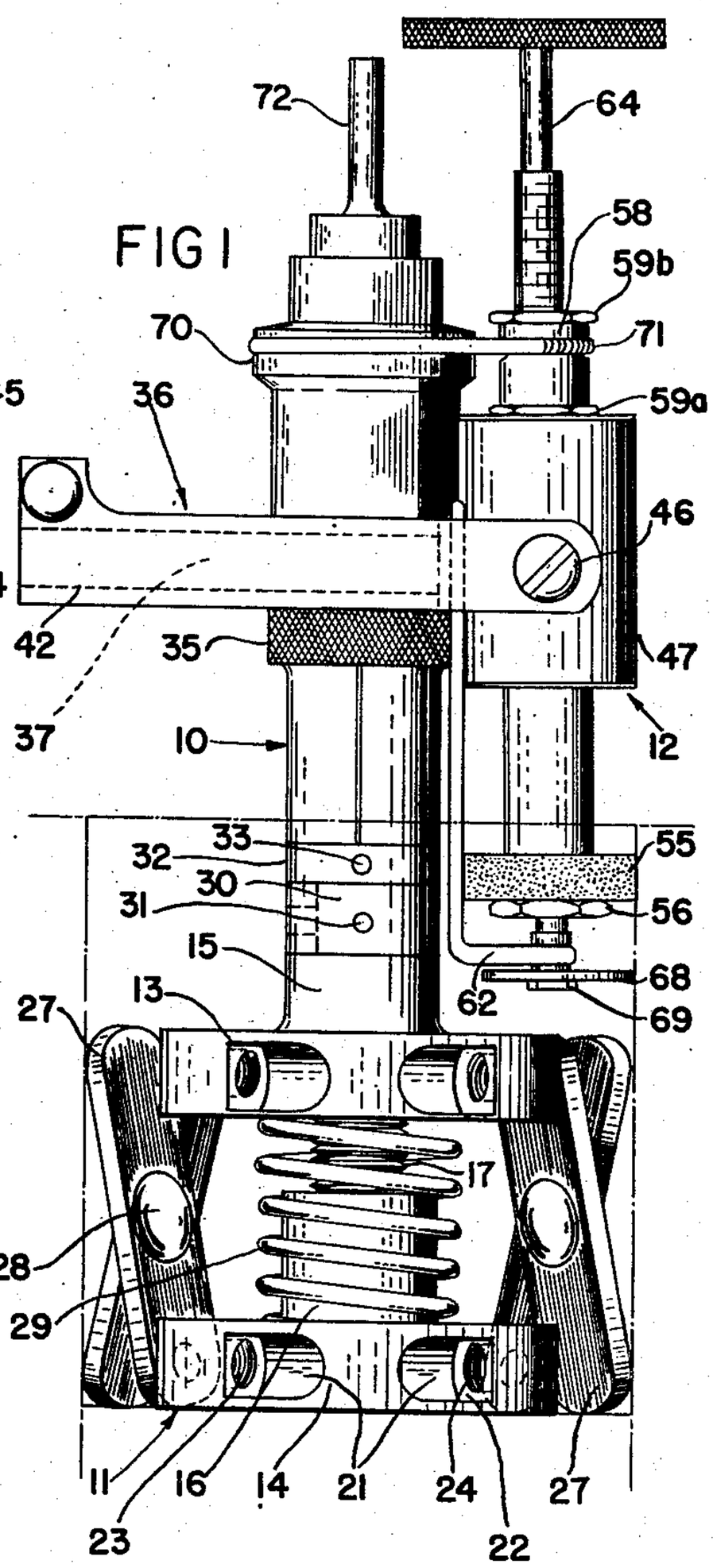


FIG 1



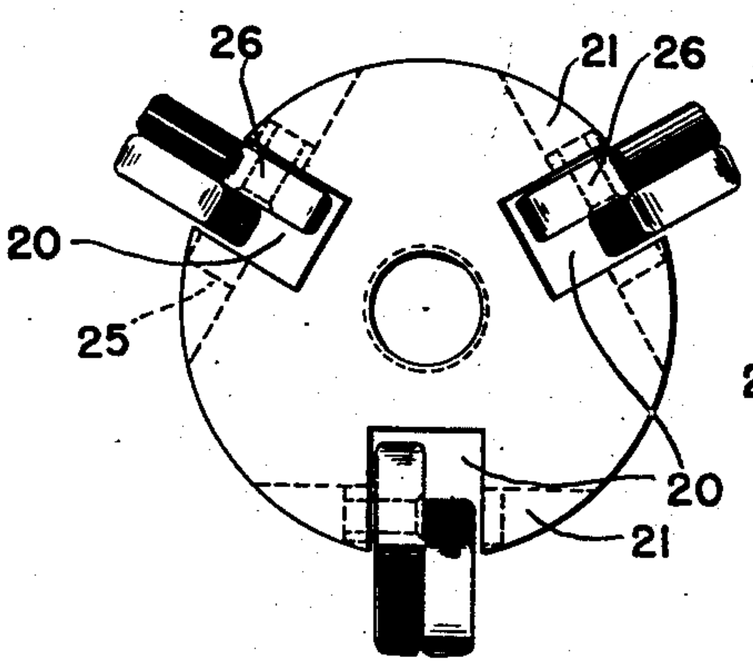
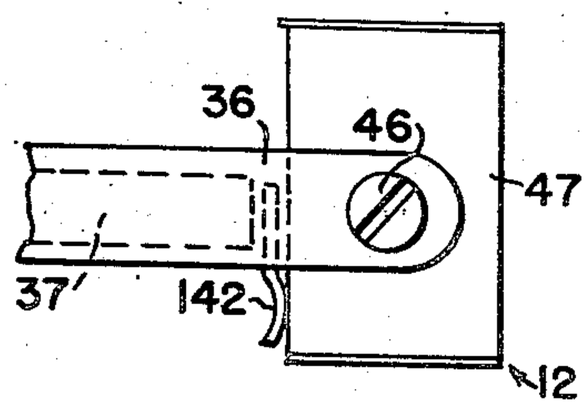


FIG 2

FIG.8



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RIDGE GRINDER FOR ENGINE CYLINDERS

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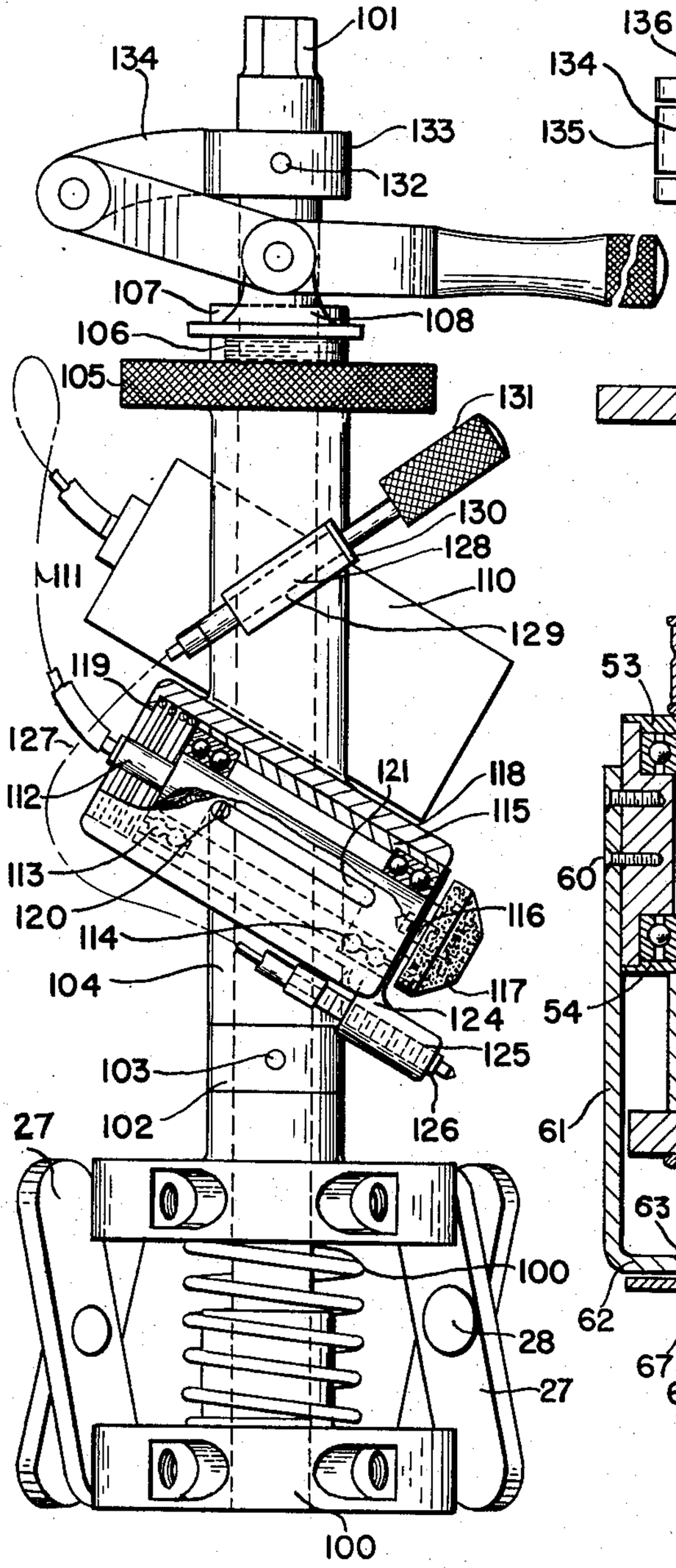

FIG. 6

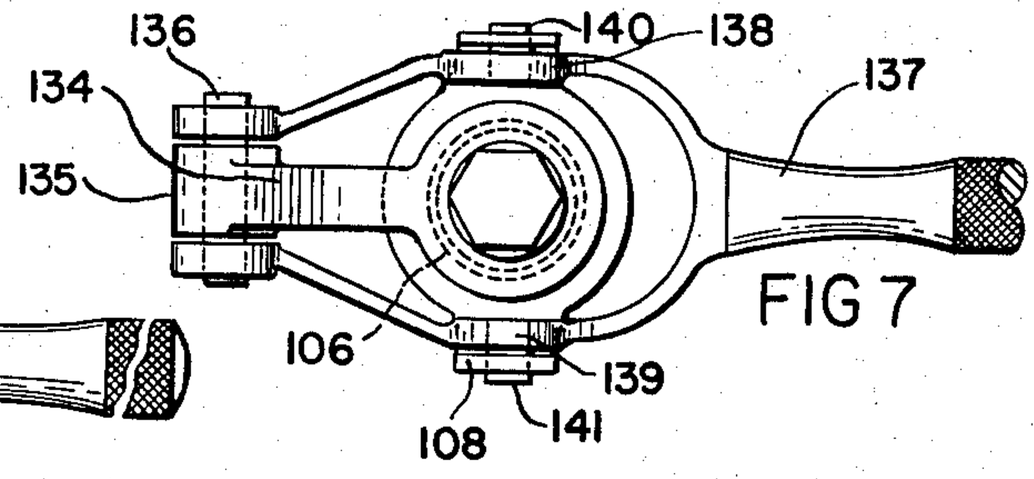

FIG 7

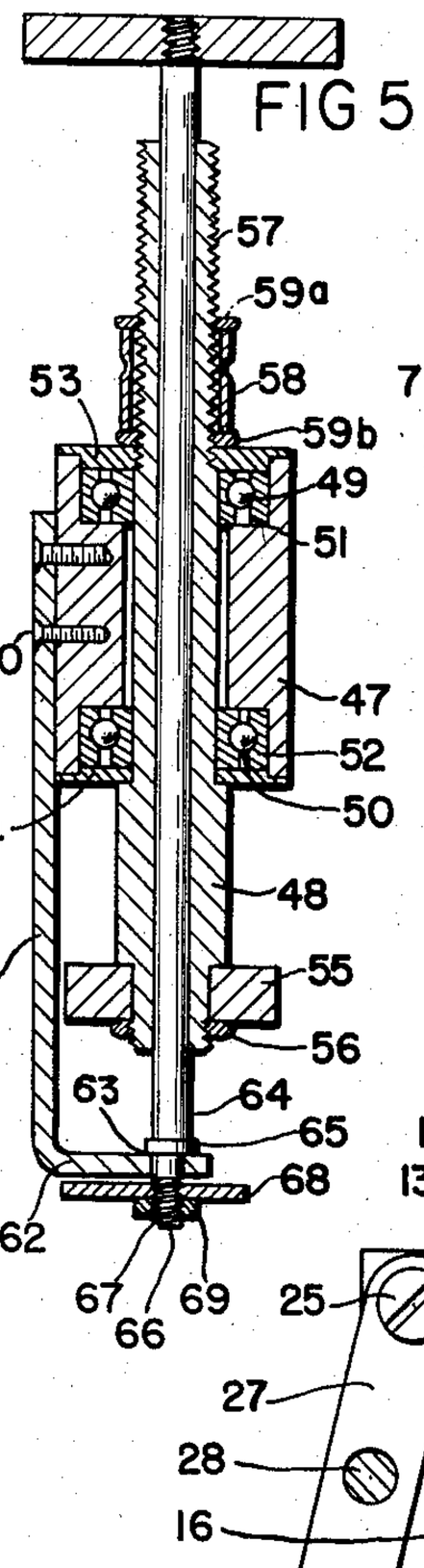

FIG 5

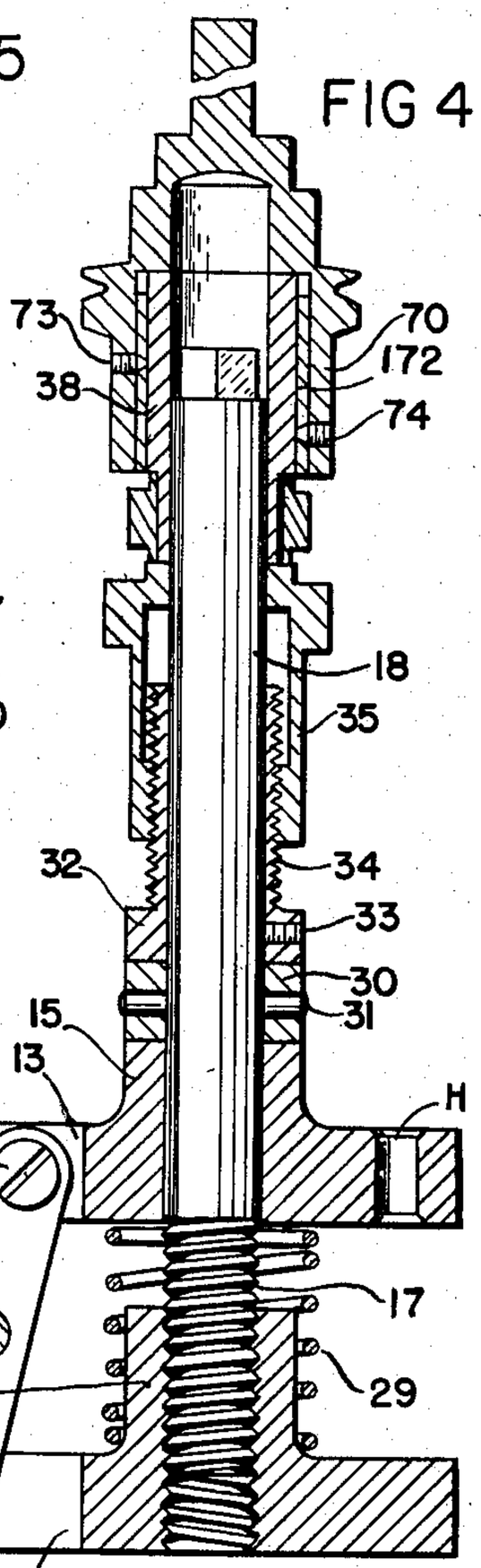

FIG 4

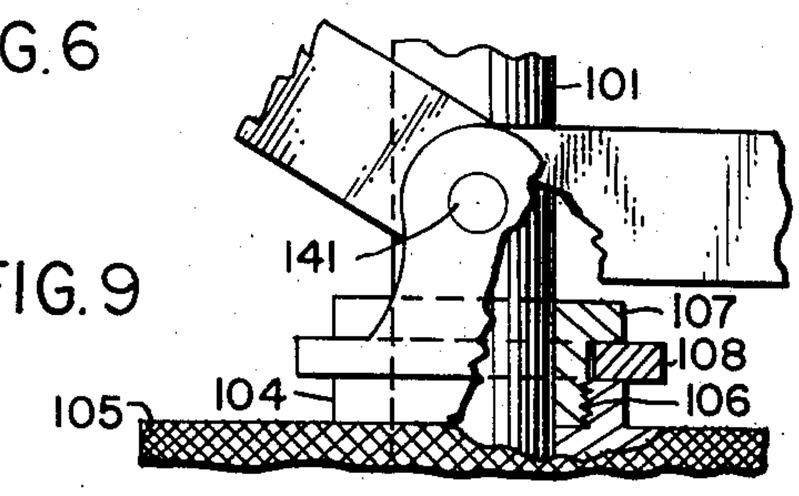

FIG. 9

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RIDGE GRINDER FOR ENGINE CYLINDERS

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6 Claims. (Cl. 51—245)

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This invention relates to the art of grinding metals to predetermined contours. More particularly, it relates to the grinding of cylinder walls.

Still more particularly, it relates to apparatus for grinding circumferential ridges from engine cylinders.

Reciprocation of pistons in cylinders causes wear on those portions of the cylinder walls contacted by the piston rings. By the time that it is necessary to replace worn piston rings, a ridge of unworn cylinder wall remains at the top of the cylinder.

In those cylinders where the pistons are inserted from the top it is often necessary to grind away the ridge in order to get the piston out of the cylinder. In cylinders where the pistons need not be removed from the top, it nevertheless is necessary to remove the ridge, because new rings are wider than the replaced rings and movement of the piston to the top of the cylinder brings the rings into engagement with this ridge. The repeated and sudden contraction of the rings as they snap over the ridge results in an early ring breakage.

Cylinder reamers currently in use rework the upper end of the cylinder wall to a round contour. This results, due to the eccentricity of the worn cylinder, in the ridge remaining on a portion of the wall and an undercutting of other portions of the cylinder wall, or, if all the ridges are removed, in a marked undercutting of portions of the cylinder.

It is an object of the present invention to overcome the disadvantages and shortcomings of apparatus heretofore utilized.

It is another object of the present invention to provide means for grinding off the entire ridge worn on cylinders without undercutting any portion of the cylinder wall.

It is a further object to provide means for grinding cylinder walls to a smooth contour longitudinally.

It is also an object of the present invention to provide a portable grinding mechanism which may be quickly mounted within a cylinder in grinding position.

It is still another object of this invention to provide apparatus which does not require accurate centering of the grinding equipment.

It is a still further object of the present invention to provide a mounting for the grinding mechanism whereby the tool quickly traverses areas requiring no grinding.

It is another object of this invention to provide an apparatus which may be mounted substantially in the cylinder with the power mechanism separate therefrom in order to get at inaccessible rear cylinders.

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These and other objects will become apparent from the following description given in connection with the drawings in which:

Figure 1 is a side elevational view of one embodiment of the invention;

Figure 2 is a bottom plan view of Figure 1;

Figure 3 is a side elevational view of the top of the apparatus of Figure 1 taken at right angles thereto;

Figure 4 is a vertical sectional view along the center line of the spindle;

Figure 5 is a vertical sectional view of the grinder mechanism;

Figure 6 is a side elevational view of a second embodiment of the invention;

Figure 7 is a top plan view of Figure 6;

Figure 8 is an elevational view showing a further embodiment of the invention having a tensioning leaf spring; and

Figure 9 is an enlarged view partially in section of a portion of Figure 6.

In brief, grinding of ridges in accordance with the instant invention is carried out by abrading the raised portion of the cylinder wall with a small diameter grinding wheel whose contact with the cylinder wall is governed by a cam action spaced from the grinder so as to contact the cylinder wall in that portion whose contour it is desirable to reproduce longitudinally.

Referring to the drawings and more particularly to Figure 1 thereof, wherein the apparatus of this invention is shown as seated in a narrow cylinder, there is illustrated a support column 10 mounted on an expanding foot mechanism 11. Supported upon column 10 is a grinding mechanism 12, the details of whose mounting will be explained in conjunction with other figures.

The expanding foot mechanism 11 consists of two plates 13 and 14 having upwardly extending axial projections 15 and 16, respectively. Plates 13 and 14 are both axially bored, the bore of plate 14 being threaded as at 17 to receive the bottom threaded end of a spindle 18.

Spindle 18 is provided at its opposite end with a hexagonal or other suitably shaped head.

Plates 13 and 14 are provided, as shown in Figure 2, with corresponding circumferentially spaced slots 20. Adjacent the slots 20, plates 13 and 14 are segmentally bored as at 21. An end wall 22 separating the slots 20 and 21 is provided with bores as at 23 which are threaded as at 24.

Each of the threaded bores 23 is adapted to

respectively receive one of the threaded portions of pins 25, whose smooth portions 26 projecting into slots 20, constitute pivots for cross links 27.

One of the links 27 is pivotally mounted by said pins 25 on plate 13, while the other link 27 is similarly pivotably mounted on plate 14. The links 27 are crossed and pivoted to each other by suitable pivot pins 28.

Surrounding the projection 16 of plate 14 and extending into contact with the inner faces of plates 13 and 14 is mounted suitable resilient means 29 such as a flexible spring.

The plate 13 is prevented from axial movement along spindle 18 by a collar 30 fixedly positioned on the spindle 18 by pin 31.

Surrounding the spindle 18 and shown resting on the collar 30, although such supporting contact is unnecessary, is a sleeve 32 positionable on said spindle for vertical adjustment by a set screw 33. Sleeve 32 is externally threaded as at 34.

Suitable means 35, such as a knurled nut, threadedly engages threads 34 to provide a fine adjustment vertically for a grinder support frame 36 resting in contact therewith. It will thus be seen that elements 33, 34 and 35 form a portion of a tubular structure surrounding the spindle 18.

Support frame 36 consists of a block 37 provided with a transverse sleeve 38. The sleeve or tubular member 38 is adapted for sliding fit with the spindle 18. Block 37 is provided at each side with guide shoulders 39 and 40. On opposite sides of the block 37 there are provided parallel arms 41 and 42 adapted with recesses 43 and 44 in which are positioned guides 39 and 40. A screw 45 engaging the arms 41 and 42 provides the means of locking said arms in any position on the block.

At the opposite end of arms 41 and 32 there is secured between the arms, by means allowing for pivoting action such as screws 46, a quill 47. Quill 47 supports a hollow rotatable shaft 48 by means of ball bearings 49 and 50, whose races 51 and 52 are mounted at each end of the quill and retained therein by retainer plates 53 and 54. Adjustment of the ball bearings in the quill is secured by a nut 59*b*.

The shaft 48 extends below the quill 47 and is provided at its lower end with a suitable grinding wheel 55 held in position by a locking nut 56. The upper end of the shaft 48 is externally threaded as at 57. This upper portion of the shaft 48 carries a suitable pulley 58 of one or more steps fixed to the shaft by suitable locking means as by being secured between locking nuts 59*a* and 59*b*.

Attached to the outside of the quill 47 by suitable means 60, such as machine screws, is a depending arm 61 having a transversely angled foot 62. Foot 62 is apertured as at 63 and adapted to receive a post 64.

Post 64 is axially mounted within shaft 48. The post is adapted for loose sliding fit therein and is provided adjacent its lower end with a shoulder 65 adapted to contact the foot 62. A portion 66 of the post 64 is threaded as at 67 and extends beyond the shoulder 65 through the aperture 63 in foot 62. This threaded projection receives a cam 68 which is locked in position by a locking nut 69.

At its upper end the post 64 is threaded and is adapted to receive a knurled nut or other suitable means for adjusting the guide cam 68.

In this embodiment of the invention it is intended that the driving connection be made between pulley 58 and a pulley 70 mounted on

sleeve 38 by suitable means 71 such as a spring belt.

Pulley 70 is provided with an extension 72 adapted for driving connection with suitable power transmission means such as a flexible shaft running from a source of power, such as an electric motor.

For applicant's purpose an electric drill has a motor sufficiently powerful to drive the grinding or abrading wheel.

While description is given with reference to power means separate from the described apparatus, it will be recognized that small fractional horsepower electric motors could be substituted for and mounted in place of the quill arrangement described.

To eliminate the ridge it is necessary to move the grinding unit through a 360° horizontal path. Rotation of the grinding unit 12 is effected through a friction drive. To accomplish this, pulley 70 is provided with an annular internal collar 172 of suitable friction material, such as hard fiber, micarta, Bakelite resin, and the like.

The collar 172 is prevented from rotating independently of pulley 70 by screws 73. The speed of rotation of the mounting for the grinding unit is governed by the adjustment of set screw 74 which forces the friction collar into engagement with the sleeve 38.

In the use of this equipment, the mount for the grinding unit and the pulley 70 are removed from the top of spindle 18. The foot with retracted links is inserted into a cylinder, as indicated by the dash-dot lines of Figure 1.

The links are moved outwardly to engage the walls of the cylinder by turning the spindle 18 by means of a wrench engaging the hexagonal head of said spindle 18, while a punch fitting in holes H prevents the plate 13 from turning.

It will be apparent at once that no attempt is made to accurately center the spindle 18. When the spindle 18 is securely fixed, the mount for the grinding unit and pulley 70 are returned to position atop said spindle.

Pulley projection 72 is connected to a source of power through a flexible shaft and the pulley 58 by means of spring belt 71.

The quill 47 is then positioned radially from spindle 18 by means of arms 41 and 42. The exact position will be dependent upon the configuration of the grinding wheel and the particular cam radius being used in conjunction therewith.

As the grinding wheel cuts into the cylinder wall its depth of cut is limited by the cam to that which makes the wall smooth longitudinally of the cylinder.

To insure that the cam will always have the most extended position, a leaf spring 142 as shown in Figure 8 may be carried by a connecting member between arms 41 and 42, which will engage the quill 47 below the pivot screws 46 and thus urge the cam 68 toward engagement with the cylinder wall.

In Figures 6 and 7 there is shown a modified arrangement, altering somewhat the mode of operation.

In Figure 6 the unit is positioned by a foot mechanism identical with that shown in Figure 1. A spindle 100 corresponding to spindle 18 extends upwardly with the hexagonal head 101 exposed at the top. Surrounding the spindle 100 adjacent the foot mechanism is a collar 102 fixed to said spindle by pin 103.

Surrounding the major portion of the balance of the spindle 100 is a tubular member 104. Tu-

bular member 104 is provided adjacent its upper end with a knurled lateral extension or knob 105 which may be used to rotate the tubular member 104. The tubular member 104 is counterbored and threaded at 106 to receive the threaded portion of a collar 107, which collar retains stirrup 108 secured about tubular member 104 from longitudinal movement; this arrangement permits the collar 107 and tubular member 104 to be rotated together while the member 100 and stirrup 108 remain stationary. When the stirrup 108 is moved in a longitudinal direction by means hereinafter described the contact of collar 107 with stirrup 108 permits the longitudinal movement of tubular member 104 and the equipment mounted thereon with the stirrup 108.

Releasably mounted on one side of tubular member 104 and transverse thereto is a small electric motor 110 provided with a flexible shaft 111 for transmission of rotative power to a shaft 112 supported in a quill 115 mounted in a housing or mounting 118, which housing extends transverse to the tubular member 104. This housing may be a casting or suitably prefabricated unit.

Releasably attached to the lower end of shaft 112 by suitable means 116, such as screws, is an abrading wheel 117 of suitable configuration. Shaft 112 is supported by ball bearings 113 and 114 having their races mounted in quill 115.

At its upper end quill 115 contacts a resilient means 119, such as a spring, which urges the quill into an extended position.

A screw 120 mounted in quill 115 and having its head slidable in a slot 121 of casting 118 limits the movement of said quill.

Quill 115 has a lug 124 either formed integral therewith or joined thereto by suitable means.

Lug 124 is axially bored and threaded at 125 to receive a threaded screw 126. Screw 126 is tipped to provide a guide finger or needle cam for contacting a cylinder wall.

Adjustment of the needle cam is obtained through a flexible shaft 127. The flexible shaft 127 connects the screw with a small rotatable rod 128. This rod is mounted in a casting 129 mounted on tubular member 104.

Rod 128 is provided with a shoulder 130 which limits its longitudinal motion in casting 129. Rod 128 is also provided at the end opposite its connection with the flexible shaft 127 with a knurled head 131 for manual operation.

Adjacent the top of spindle 100 there is mounted, by means of a set screw 132, a collar 133. Collar 133 is provided with a radially extending arm 134 which terminates in a tubular member 135. Member 135 is adapted to serve as a bearing for pivot rod 136.

Rod 136 serves as a fixed pivot point for handle 137. Handle 137 is bifurcated with the arms passing on opposite sides of the spindle 100. The arms of the handle 137 are bored in alignment with the horizontal transverse axis of the spindle as at 138 and 139.

The apertures 138 and 139 are adapted to receive pins 140 and 141 which pass through the upstanding legs of stirrup 108 and form the pivot whereby the tubular member and all members mounted thereon may be raised or lowered. Thus as shown in a broken-away view in Figure 9 the stirrup 108 when raised by the application of a force to the handle (137) engages the collar 107 moving the same upwardly; as collar 107 is threaded at 106 to tubular member 104 the latter and the equipment mounted thereon are raised with the collar 107 and the stirrup 108 as noted

hereinbefore. Also as may be seen in Figure 9 a twisting motion applied to knob 105 will permit the tubular member 104 and the collar 107 threaded therein to rotate with respect to the stirrup 108.

The apparatus it will be immediately recognized is adapted for manual adjustment for depth of cut and manual manipulation in both the horizontal and vertical directions.

Additional alternative features which may be embodied, for example, in the apparatus of Figure 1, is the driving of shaft 48 directly by means of a flexible shaft or the substitution of a small fractional horsepower electric motor in place of quill 47.

In the event of direct drive to shaft 64 the pulley and friction drive would function solely for turning the grinding apparatus mounting in a circular path.

It will be seen from a study of Figure 1 that belt 71 is a means urging the pivoting of the quill about the pivot 46 and thus bringing the cam 68 and grinding wheel 55 into engagement with the cylinder wall.

In order to provide for a more continuous application of pressure and less chattering, the spring mount described earlier is preferred in order to maintain the angularity of the quill to the wall being abraded.

While the method and apparatus disclosed and described herein illustrate a preferred form of invention, yet it will be understood that modifications can be made without departing from the spirit of the invention, and that modifications that fall within the scope of the appended claims are intended to be included herein.

I claim:

1. In an engine cylinder grinding machine, in combination, a spindle having an expansible foot at one end thereof, a tubular structure surrounding a central portion of the spindle slidable longitudinally thereon and in rotational engagement therewith, a mounting supported on and extending transversely to and beyond said tubular structure at said central portion of said spindle, said mounting being movable longitudinally with respect to said spindle, a grinding unit pivotally supported on said mounting and extending parallel with said spindle, said grinding unit comprising a quill, a shaft rotatably mounted in said quill and extending therefrom, a grinding wheel on the lower end of said shaft, and guide means supported from said quill and positioned below said grinding wheel in spaced vertical relation therewith, spring means positioned above the said grinding wheel retained on the mounting and engaging between the said quill and transverse mounting and resiliently urging the said quill, shaft and grinding wheel into an extended position outwardly from said spindle, and means secured to said tubular structure above said mounting for moving said mounting and tubular structure in paths about said spindle.

2. In an engine cylinder grinding machine, in combination, a spindle having an expansible foot at a lower end thereof, a tubular structure surrounding a central portion of the spindle slidable longitudinally thereon and in rotational engagement therewith, a mounting secured on and extending transversely to and beyond said tubular structure at said central portion of said spindle, said mounting being movable longitudinally on said structure with respect to said spindle, a grinding unit supported on said mounting, said grinding unit comprising a quill, a shaft rotatably mounted in said quill and extending

therefrom, a grinding wheel on the lower end of said shaft, and guide means supported from said quill and positioned below said grinding wheel in spaced vertical relation therewith, spring means positioned above the said grinding wheel retained on the mounting and engaging between the said quill and mounting and urging the said grinding wheel into an extended position outwardly from said spindle, means secured to said tubular structure above said mounting for moving said mounting and tubular structure in substantially circular paths about said spindle, and means secured to said shaft of said grinding unit for driving said grinding wheel in rotation.

3. In an engine cylinder grinding machine, in combination, a spindle having an expansible foot at a lower end thereof, a tubular structure surrounding a central portion of the spindle in sliding engagement therewith, a mounting secured on and extending transversely to and beyond said tubular structure at said central portion of said spindle, a grinding unit supported on said mounting, said grinding unit comprising a quill, a shaft rotatably mounted in said quill and extending therefrom, a grinding wheel on the lower end of said shaft, and guide means supported from said quill and positioned below said grinding wheel in spaced vertical relation therewith, spring means positioned above the said grinding wheel in said mounting and engaging the said quill and urging the said grinding wheel into an extended position outwardly from said spindle, knob means secured to said tubular structure above said mounting for moving said mounting and tubular structure in substantially circular paths about said spindle, an electric motor secured to said tubular structure above said grinding unit, and a flexible shaft connecting said motor and shaft of said grinding unit for driving said shaft and grinding wheel in rotation.

4. In an engine cylinder grinding machine, in combination, a spindle having an expansible foot at a lower end thereof, a tubular structure surrounding a central portion of the spindle in sliding engagement therewith, a mounting secured on and extending transversely to and beyond said tubular structure at said central portion of said spindle, means engaging said tubular structure at an end portion thereof for sliding said tubular structure on said spindle, a grinding unit supported on said mounting, said grinding unit comprising a quill, a shaft rotatably mounted in said quill and extending therefrom, a grinding wheel on the lower end of said shaft, and guide means supported from said quill and positioned below said grinding wheel in spaced vertical relation therewith, spring means positioned above the said grinding wheel secured to the said mounting engaging between the said quill and mounting and resiliently urging the said grinding wheel into an extended position outwardly from said spindle, and means secured to said tubular structure above said mounting for moving said mounting and tubular structure in substantially circular paths about said spindle.

5. In an engine cylinder grinding machine, in combination, a spindle having an expansible foot at a lower end thereof, a tubular structure surrounding a central portion of the spindle in sliding engagement therewith, a mounting secured on and extending transversely to and beyond said

tubular structure at said central portion of said spindle, a stirrup secured to an upper end portion of said tubular structure, handle means secured to said stirrup for sliding said stirrup and tubular structure on said spindle, a grinding unit supported on said mounting, said grinding unit comprising a quill, a shaft rotatably mounted in said quill and extending therefrom, a grinding wheel on the lower end of said shaft, and guide means supported from said quill and positioned below said grinding wheel in spaced vertical relation therewith, spring means positioned above the said grinding wheel in said mounting and engaging the said quill and urging the said grinding wheel into an extended position outwardly from said spindle, knob means secured to said tubular structure above said mounting from moving said mounting and tubular structure in substantially circular paths about the said spindle.

6. In an engine cylinder grinding machine, in combination, a spindle having an expansible foot at a lower end thereof, a tubular structure surrounding a central portion of the spindle in engagement therewith, a mounting secured on and extending transversely to and beyond said tubular structure at said central portion of said spindle, an externally threaded sleeve secured to said spindle below said tubular structure, a nut threadedly engaging said sleeve and in engagement with a lower end portion of said tubular structure for sliding the same on said spindle, a grinding unit supported on said mounting, said grinding unit comprising a quill, a shaft rotatably mounted in said quill and extending therefrom, a grinding wheel on the lower end of said shaft, and guide means supported from said quill and positioned below said grinding wheel in spaced vertical relation therewith, spring means positioned above the said grinding wheel and contacting the said grinding unit and urging the said grinding wheel into an extended position outwardly from said spindle, and means secured to said tubular structure for moving said mounting in substantially circular paths about said spindle.

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