Oct. 12, 1943. F. G. WACKER 2,331,523

CYLINDER GRINDING TOOL

Filed Nov. 24, 1941 3 Sheets-Sheet 1

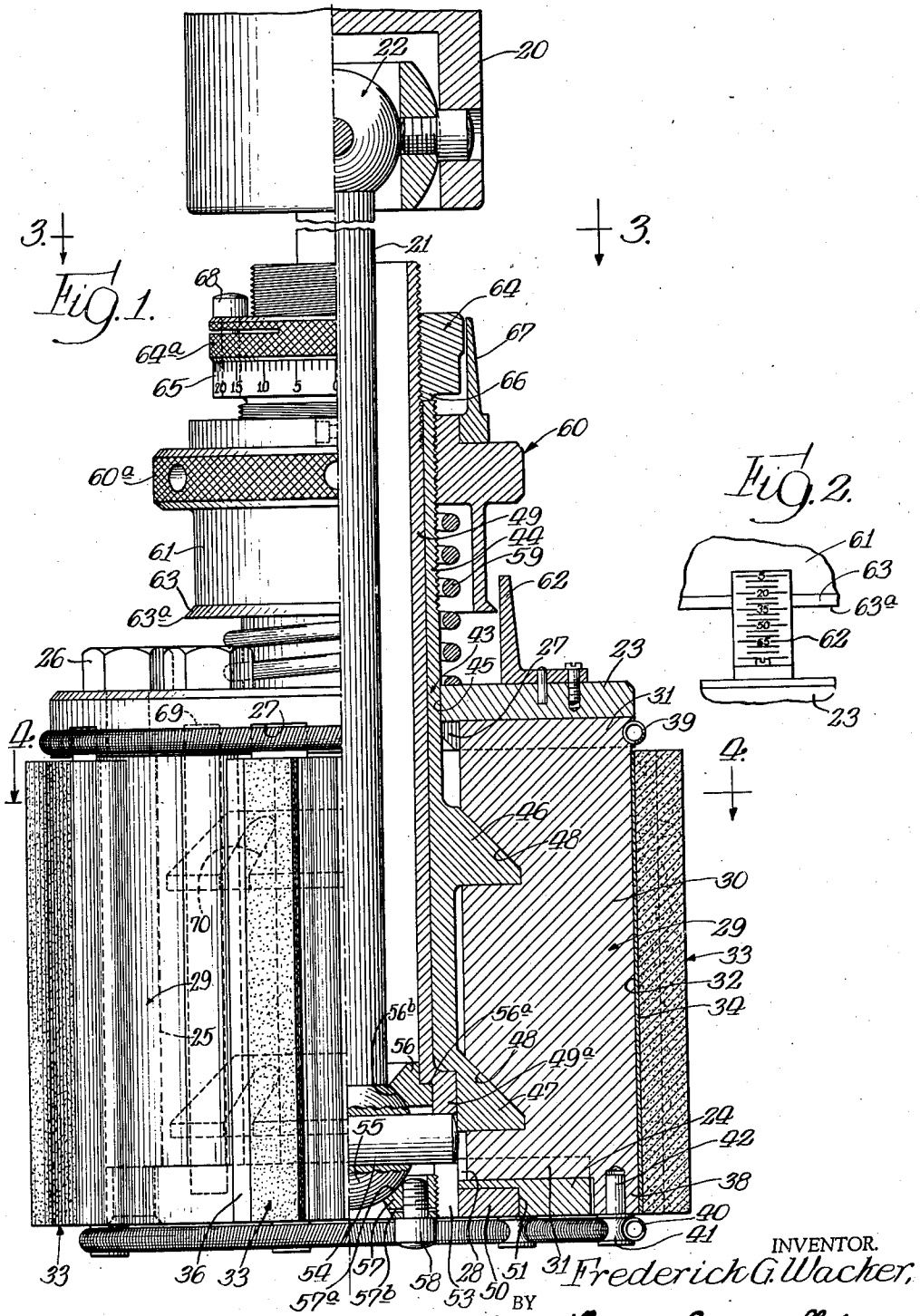


Fig. 1.

Fig. 2.

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Fig. 3.

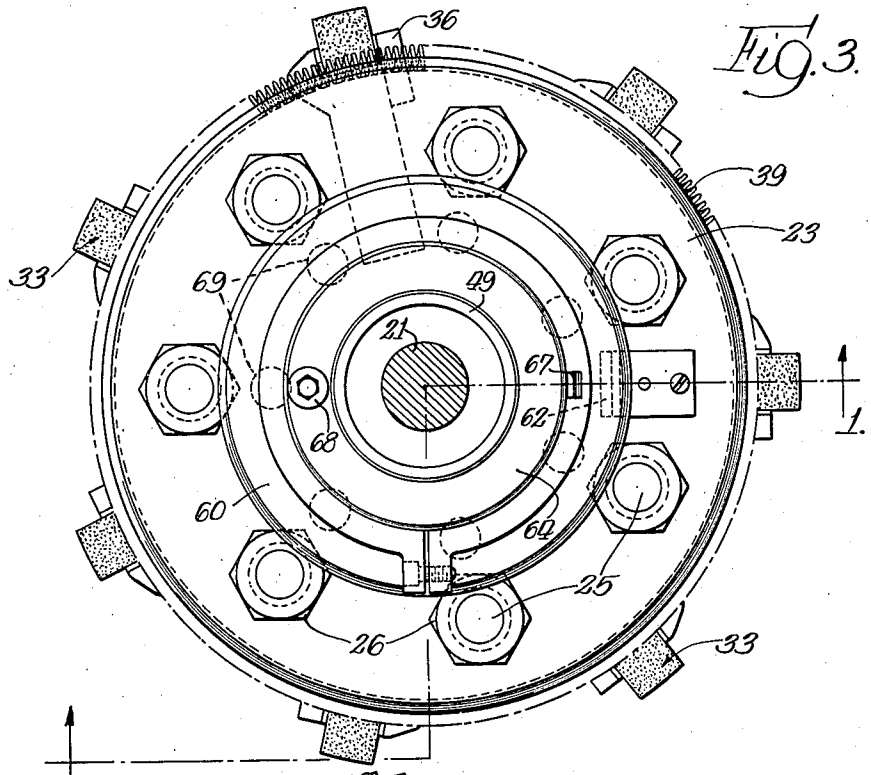
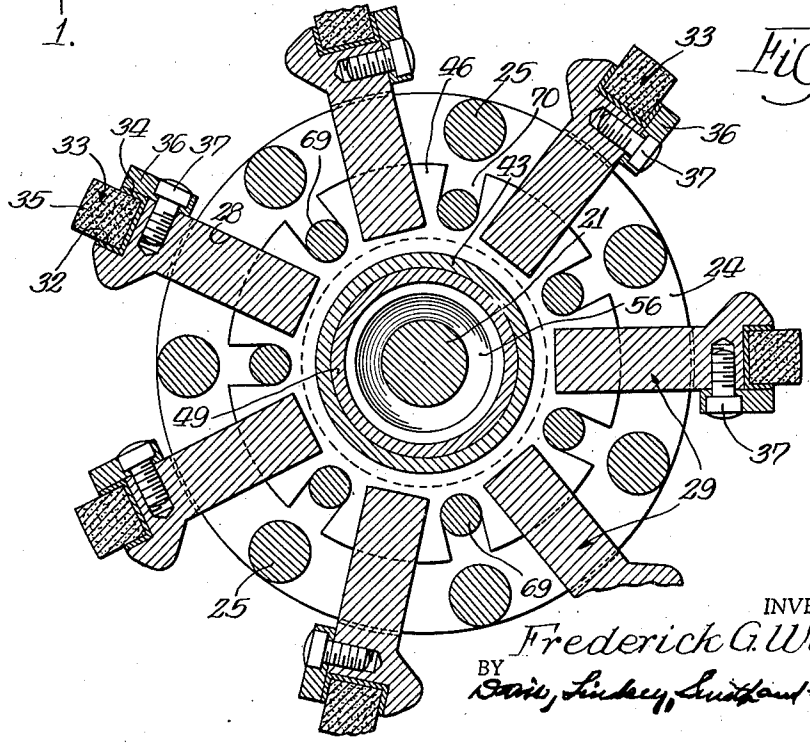


Fig. 4.



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Fig. 7.

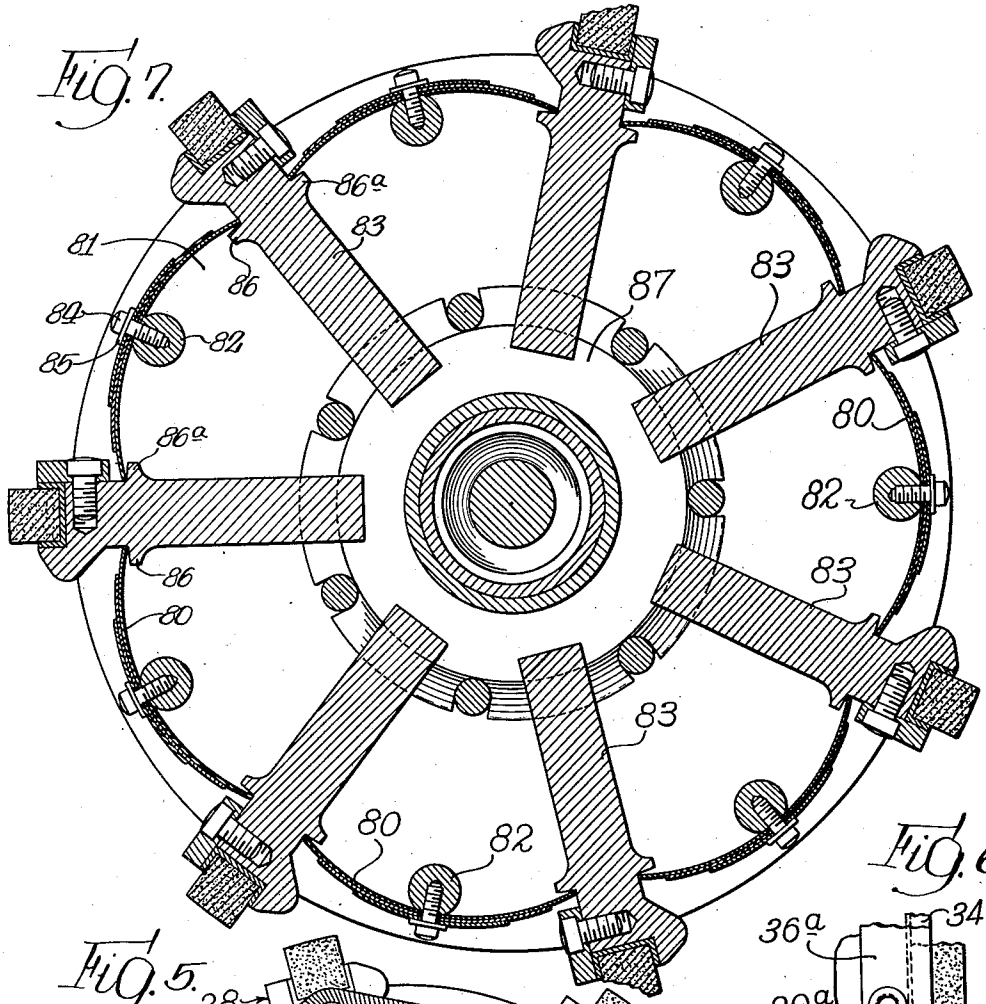


Fig. 6.

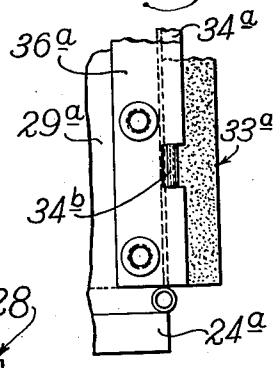
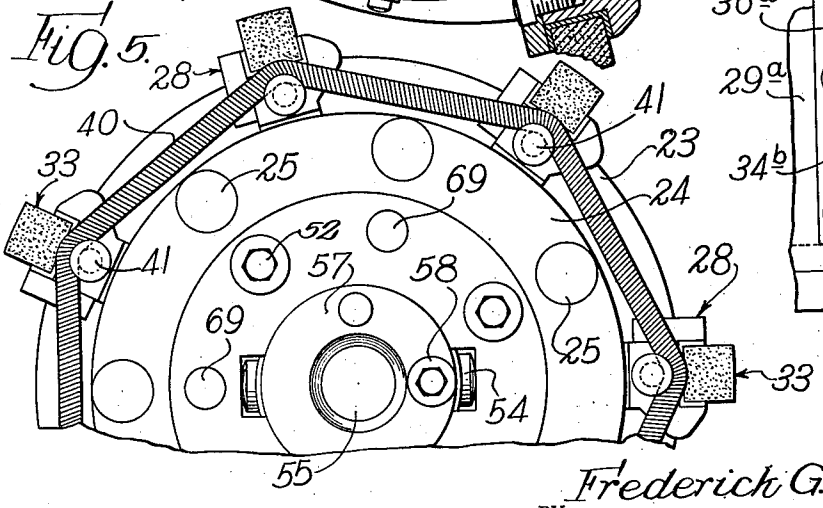


Fig. 5.



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2,331,523

UNITED STATES PATENT OFFICE

2,331,523

CYLINDER GRINDING TOOL

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Application November 24, 1941, Serial No. 420,224

21 Claims. (Cl. 51—184.3)

My invention relates to cylinder grinding tools and it has to do with a tool of a character particularly well suited for use in the factory production field.

One of the objects of my invention is to provide an improved tool of the foregoing character which is compact and durable, which may be manufactured cheaply, and which is adapted for greater accuracy and efficiency in the grinding of cylinders.

Another object is to provide a tool of the foregoing character having an improved drive.

A further object is to provide improved means for positively determining the extent of grinding, which means cooperates with adjustable tool expanding mechanism to grind a particular cylinder to a predetermined extent and to insure the grinding of successive cylinders to the same predetermined size.

An additional object is to provide a tool of the foregoing character wherein the grinding operation may be carried on under variable pressures to accommodate the grinding of materials of varying hardness with a minimum of wear and deterioration of the grinding members, as well as to accommodate varying conditions in the grinding of the same material, all to the end that the grinding operation may be carried out more quickly, accurately and efficiently.

Another object is to provide a cylinder grinding tool having its parts constructed and arranged for precision grinding operation.

Still another object is to provide a cylinder grinding tool having adjusting mechanism so constructed and arranged that it is independent of the tool driving mechanism whereby the tool adjustment is not affected by disalignment between the tool and its driving means, the adjusting mechanism is free of joints which tend to wear and cause misadjustment of parts of the adjusting mechanism, and is not affected by wear and looseness of parts of the driving mechanism.

A further object is to provide a cylinder grinding tool adapted for the grinding of cylinders of varying lengths, which tool, however, is so constructed and arranged as to substantially reduce the height of the tool and its driving means.

Another object is to provide a cylinder grinding tool adapted for the grinding of a wide range of cylinder diameters.

An additional object is to provide a cylinder grinding tool having a rigid body with axially spaced end plates supporting radially expansible abrasive carriers, the tool being driven through a universal joint connecting a driving spindle with the lower or bottom end plate of the tool body.

A further object is to provide improved spring-type retracting means opposing radial expansion of the stone carriers.

Other objects and advantages will become apparent as this description progresses and by reference to the drawings, wherein—

Figure 1 is a vertical sectional view, partially in elevation, showing one form of tool embodying my invention, which view is taken substantially on line 1—1 of Fig. 3;

Fig. 2 is a fragmental elevational view of the pressure indicating means shown in Fig. 1;

Fig. 3 is a section taken substantially on line 3—3 of Fig. 1;

Fig. 4 is a section taken substantially on line 4—4 of Fig. 1;

Fig. 5 is a partial bottom-plan view of the structure shown in Fig. 1;

Fig. 6 is a fragmental sectional view of an abrasive carrier having a grinding stone unit mounted therein, and illustrating an improved form of interlock between the abrasive carrier and the stone unit; and

Fig. 7 is a view similar to Fig. 4 illustrating an improved form of spring support for the stone carriers.

The tool shown in the drawings, while being especially adapted for so-called production use, may also be used in the service field or in any other field where it may have utility. In production use of a tool of this type, it is usually driven by a machine (not shown) having a driving spindle. Referring particularly to the tool shown in Figs. 1 to 5, inclusive, the machine spindle is provided with a head 20 which is drive-connected to one end of a tool spindle 21 by a universal drive connection 22 (Fig. 1). The other end of the tool spindle 21 is connected to the tool body, which will now be described.

The tool body, which is of the so-called rigid frame type, includes axially spaced apart top and bottom plates 23 and 24 which are rigidly joined together by circumferentially spaced posts 25. The posts 25, preferably, have their ends riveted in the bottom plate 24 and their upper ends threaded and passing through openings in the top plate 23 to receive nuts 26 which, when tightened, provide a rigid cage-like frame structure with passageways between the posts 25 for the mounting of abrasive carriers.

The bottom plate 24 is of less diameter than the top plate 23 for a purpose which will be described later, and the facing surfaces of the end

plates are provided with radially directed grooves 27 and 28, respectively, for receiving and adjustably supporting abrasive carriers 29. All of the abrasive carriers are of like construction and only one will be described in detail.

The abrasive carriers are sometimes referred to as stone carriers and each includes a flat, rectangularly shaped body portion 30 having end tongue-like portions 31 which are snugly and slidably received in the end plate grooves 27 and 28 for radial expanding movement of the stone carrier. The outer edge portion of the carrier is provided with a thickened head portion which is slotted to provide a longitudinally extending channel 32 in which is received a grinding stone unit 33. This latter unit includes a channel member 34 in which is secured a grinding stone 35, the stone unit being securely locked in the carrier channel 32 by a longitudinally extending block 36 engaging one side of the stone unit channel member 34 and secured to the stone carrier by screws 37. In order that the stone unit may be frictionally clamped in place by the block 36, such unit is just slightly wider than the carrier channel 32 so that the desired gripping action will be accomplished when the block 36 is tightened in place by the screws 37. The grinding stone 35 is, preferably, adhesively secured to its supporting channel 34, and the block 36 is solely relied upon to hold the stone unit 33 in place. However, if desired, the channel member may be additionally and positively secured to the stone carrier in the manner illustrated in Fig. 6. More particularly, the channel member 34^a of the stone unit 33^a is provided, at each side, with struck-out portions rolled outwardly to provide bead-like elements 34^b. The stone unit 33^a is clamped in place by a block 36^a which forms one side of the stone unit receiving channel of the stone carrier 29^a. The block 36^a and the other side of the carrier channel are provided with notches 29^b in which the bead-like elements 34^b are received.

Although my invention is adapted for the grinding of different types of cylinder bores, the tool shown in Fig. 1 is adapted particularly for the grinding of so-called blind bores, or bores with a closed bottom wherein the tool cannot be reciprocated through and partially beyond the bottom of the bore. In that case it is desired that the grinding action be carried on to the full depth of the stroke of the tool and, to accomplish that, the outer edge of the stone carrier is provided with a lower over-hang portion 38 which extends downwardly over the outer peripheral surface of the reduced-diameter bottom plate 24. When open bores are to be ground and this over-hang is not desired, the carrier may be formed as shown in Fig. 6 and the bottom plate 24^a may be the same diameter as the top plate. Again referring to Fig. 1, the carriers 29 are retained against outward displacement from the grooves 27 and 28 by a pair of garter springs 39 and 40 located at the opposite ends of the carriers. The upper garter spring 39 is seated in a complementally shaped slot in each of the upper carrier tongues 31, while the lower spring 40 is carried by an annularly disposed group of spool-like members 41 having stems 42 fixedly mounted in the over-hanging portions 38 of the carriers.

The stone carriers 29 are radially supported by a centrally disposed cone-type expander unit 43 which is shiftable axially to expand the carriers 29 radially outward. This cone unit comprises a tubular stem-like portion 44 slidably mounted in and passing through an opening 45 in the top plate 23. The stem 44 extends through the central portion of the body to near the lower end thereof and it is provided, within the body, with a pair of axially spaced integral cones 46 and 47. These cones are received in complementally shaped slots 48 formed in the inner edges of the carriers 29 whereby, when the cone unit 43 is shifted upwardly, the carriers 29 are expanded radially outward, being held in firm engagement with the cones by the garter springs 39 and 40 and, when it is shifted in the opposite direction, the carriers are contracted through the action of the garter springs 39 and 40. The springs 39 and 40 are comparatively weak, exerting only sufficient pressure to hold the carriers 29 firmly seated against the cones 46 and 47 and to contract the carriers when the cone unit is moved in tool-contracting direction.

The cone unit 43 is further supported for axial movement by a central tubular member 49 disposed within and throughout the length of the cone unit tube 44 and projects therebeneath for rigid connection with the body bottom plate 24. More particularly, the lower end of the tubular member 49 is provided with an offset, increased-diameter portion 49^a which extends through an opening in the bottom plate 24, the lower portion of such extending part being outwardly flanged at 50 and received in a recess 51 in the bottom plate. The flange 50 is secured to the bottom plate 24 by an annular series of stud-and-bolt devices 52 (Fig. 5). In this manner the tubular member 49 is rigidly fixed to the body and it serves as a slide support for the cone unit 43, the lower cone 47 of such unit being cut back and complementally shaped to accommodate the lower offset portion 49^a of the member 49.

The tool is driven from the bottom plate 24 through the spindle 21 and the tubular member 49. To this end, the lower end of the tubular member 49 is provided with diametrically opposed slots 53 in which is received the pin 54 carried by a ball end 55 on the lower end of the spindle 21 and forming part of a universal joint. The upper surface of the ball end 55 is seated against a two-part circular ring 56 having a shoulder 56^a engaging a shoulder on the tubular member 49 provided by the offsetting of the portion 49^a thereof. The ring 56 is provided with a lower curved bearing surface 56^b against which the ball 55 seats. The ball end 55 is retained in driving relation by a nut 57 mounted in the lower threaded end of the tubular member 49, which nut is provided with a curved bearing surface 57^a against which the lower part of the ball 55 seats. The nut 57 is split as at 57^b and is provided with a threaded opening through the split portion for reception of a threaded lock stud 58 which, when tightened, securely locks the nut in place. The ring 56 and the nut 57 serve as confining thrust bearings for the ball end 55 of the spindle 21. Also, the slots 53 in which the universal pin 54 is received are elongated sufficiently to permit the pin and, in turn, the spindle to rock in a direction at right angles to the rotary movement permitted by such pin, thereby providing a joint affording universal action of the spindle 21.

In the use of a tool of the foregoing character, it is highly desirable that the pressure with which the grinding stones 35 are engaged with the cylinder wall, as well as the extent of the grinding operation, be controlled. For most efficient

operation, a different grinding pressure is desirable for grinding materials of different hardness. Also, a different or initial and lesser pressure is desirable for initially grinding a newly turned or formed cylinder for preliminarily removing tool marks and high points. It has been found that if the full grinding pressure is initially employed before the tool marks and high points are removed, there is a tendency to rapidly break down or tear apart the grinding stones, materially reducing the life thereof. My invention takes care of the foregoing condition in a new and novel manner in which different unit stone pressures are effectively employed for grinding different materials or handling different conditions of the same material.

Specifically, during the grinding operation, the stone carriers 29 are automatically expanded under the control of a spring 59 which may be adjusted or loaded to obtain different unit stone pressures as well as to effect a desired range of carrier expansion. To the foregoing end, the spring 59 surrounds the upper tubular portion 54 of the cone unit 43 with its lower end seated against the top end plate 23. The upper end of the tubular portion 44 of the cone unit 43 is externally threaded to receive an adjusting nut 60 having a reduced-diameter skirt portion 61 which extends down over and houses the upper end of the spring 59 which is confined between the top end plate 23 and the adjusting nut 60. It will be seen by reference to Fig. 1 that when the nut 60 is screwed downwardly the spring 59 is compressed so as to yieldingly urge the cone unit 43 and the nut 60 upwardly and, in turn, expand the carriers 29 against the slight pressure exerted by the garter springs 39 and 40. Therefore, with the carriers retracted, the tool may be inserted in a cylinder and the nut 60 screwed downwardly, expanding the carriers until the grinding stones 35 seat against the cylinder wall. No further expansion of the stone carriers will take place until the grinding operation occurs. However, to insure the grinding operation under pressure, after the stones have been set against the cylinder wall, the adjusting nut 60 is screwed downwardly to an additional and predetermined extent, thereby placing the spring 59 under additional compression for exerting a selected grinding pressure. In that way the spring 59 is caused to urge the grinding stones against the cylinder wall under an accurately determined unit stone pressure. There is a definite relationship between the threads of the adjusting nut 60 and the threads on the tubular part 44 of the cone unit 43, and between the cones 46 and 47 and the carrier surface engaged thereby, whereby a certain compression of the spring 59 by turning down the nut 60 to a predetermined extent produces a certain spring load exerting a predetermined unit stone pressure. By "unit stone pressure" I mean the pressure applied over each square inch of stone area in engagement with the cylinder wall.

In order that the operator may accurately determine the unit stone pressure employed, I provide a scale 62 carried by and extending upwardly from the top end plate 23 in alignment with the lower edge of the nut skirt 61. The nut skirt 61 is provided at its bottom with a V-shaped flange 63 providing a rather sharp peripheral edge 63a coinciding with the scale 62. The scale 62 is, preferably, calibrated to indicate in terms of pressure the unit stone pressure employed. In other words, as the nut 60 is screwed upwardly or downwardly along the scale 62 at any predetermined position along the scale, the tool is set for a certain unit stone pressure.

When the tool is in a cylinder and adjusted for a predetermined unit stone pressure, operation of the tool results in the grinding of the cylinder wall and, as the grinding takes place, the spring 59 automatically expands the stone carriers 29, the arrangement being such that throughout the range of grinding operation the spring 59 exerts a substantially constant or uniform unit stone pressure against the cylinder wall. In the honing of cylinders formed of cast iron or mild steel a maximum unit stone pressure ranging from twenty to thirty pounds may be employed in finally grinding the cylinder. If it is a newly formed cylinder, the adjusting nut may be initially set for a unit pressure of approximately five pounds and the tool operated to grind down the tool marks and high points. After this has been done the tool may then be stopped and the nut 60 adjusted to the maximum working pressure, after which the grinding operation is continued. In boring cylinders formed of harder material, greater pressures may be employed, the particular pressure depending upon the hardness of the material.

It is desirable for accuracy in the grinding of a single cylinder as well as successive cylinders and for facilitating the work of the operator so that the work may be performed more accurately and quickly, to provide adjustment limiting means which may be preliminarily set for determining the extent of the grinding operation. In carrying out my invention I provide a stop or expansion limiting means on the tool itself, as distinguished from the driving mechanism, which cooperates with the floating cone unit 43 to accomplish the result stated.

Specifically, the upper end of the tubular member 49 is exteriorly threaded, and an adjustable stop nut 64 is mounted thereupon. This stop nut is provided with an upper exteriorly-knurled portion 64a that may be grasped for ready adjustment of the same, and a lower reduced portion having a scale 65 thereon calibrated to indicate expansion of the stone carriers 29 in thousandths of an inch. In other words, the threads of the nut 64 are so related to the threads of the tubular member 49 that the extent of screwing the nut 64 up or down on the member 49 is represented in terms of thousandths of an inch on the scale 65. As hereinabove explained, the cone unit 43 is moved upwardly in expanding the stone carriers 29—hence, by disposing the stop nut 64 axially in the path of upward movement of the upper end of the tubular portion 44 of the cone unit 43, the extent to which the stone carriers may expand may be definitely determined. To this end, the lower part of the nut 64 beneath the scale 65 is provided with a reduced circumferential rim or bead-like portion 66 which is disposed in vertical alignment with the upper end of the cone unit tube 44. In use, preferably after the pressure adjusting nut has been set up to just engage the grinding stones 35 with the cylinder wall, the nut 64 is screwed downwardly into engagement with the upper end of the cone tube 44. The operator then notes the position of the scale 65 with respect to the indicating element 67 carried by the nut 60 and, if it is desired to remove, for example, .010" material from the cylinder wall, the nut 64 is backed away from the upper end of the tube 44 .010", as indicated on the scale 65. It will be

appreciated that in removing .010" material from the wall of a cylinder, the grinding stones will wear away to a certain extent, for example, .005" in the grinding of a cast iron cylinder. Therefore, in order to more accurately remove .010" material from the cylinder wall, the operator will back the nut 64 away from the end of the cone tube 44 an additional .005", or a total of .015". This nut 64 is then locked in that set condition by the lock stud 68 passing through a slitted portion of the nut, as best shown in Fig. 1. When the grinding operation is carried on, the stone carriers will gradually be expanded as material is removed from the cylinder wall, the cone unit gradually moving upwardly until its upper end finally strikes the bead 66 on the stop nut 64, when the tool can no longer expand and no further material will be removed from the cylinder wall. The tool may then be removed from the cylinder by adjusting the nut 60 upwardly to unload the spring. If another cylinder is to be similarly ground, the pressure nut 60 is adjusted upwardly to contract the stone carriers to permit the same to be inserted in the new cylinder. When that is done and the tool is inserted in the next cylinder, if the same amount of material is to be removed, the stop nut 64 need be further adjusted to merely compensate for stone wear and the nut 60 is adjusted to load the spring 59 for the proper unit stone pressure.

The cones 46 and 47 are additionally supported and guided by an annular row of posts 69 carried by the end plates 23 and 24 and disposed inwardly of the posts 25. The posts are located at such a point that they are received in radial slots 70 formed in the cones 46 and 47. With this arrangement, the expander cones are not only additionally supported for axial slide movement, but added rigidity is provided in the tool as a whole.

If desired, the stone carriers may be yieldably held in engagement with the expander cones and may be radially retracted by the spring arrangement shown in Fig. 7. The tool shown in Fig. 7 is similar to that previously described except that the garter springs 39 and 40 have been omitted and individual leaf springs 80 substituted therefor. More particularly, the frame end plates 81 (only one shown in Fig. 7) are supported in spaced relation by an annular series of posts 82 forming radial passageways in which are located stone carriers 83. These stone carriers are supported for radial slide movement by the end plates as described in connection with the form of Figs. 1 to 5. Each of the posts 82 supports, near its center, a spring 88 which comprises a plurality of spring leaves of different lengths arranged in overlapping relation. The posts 82 are disposed, preferably, midway between the carriers 83, and the longer and innermost one of each of the spring leaves extends into engagement with the two adjacent carriers. Each of the springs 80 is secured to the posts 82 by a screw 84 and washer 85. Each carrier 83 is provided with side lugs 86, 86a against the outer faces of which the ends of the springs 80 seat and urge the carriers inwardly against the expander cones 87 (only one shown in Fig. 7). The springs 80 are so constructed and the parts are so located relatively that, when the tool is fully contracted, the opposite ends of the springs 80 engage the lugs 86 and 86a of adjacent carriers under a slight tension, holding the carriers yieldably engaged with the cones 87. Obviously, expansion of the carriers is yieldably opposed by the springs 80 which insure inward movement of the carriers when the tool is contracted.

It is believed that the operation and advantages of my invention will be readily understood from the foregoing description. A tool embodying my invention is of rugged construction, is compact and is well suited for production work. It is a precision tool capable of fine adjustment for accurate cylinder grinding work. It insures the proper unit pressure for the work to be done, thereby greatly increasing the efficiency of tools of this kind. It insures the proper pressure for materials of varying hardness as well as the proper pressure at different stages of grinding a particular material. This not only provides for a more efficient use of the grinding stones but a properly honed cylinder results in less time. The desired unit pressure is maintained substantially constant throughout a wide range of expansion movement of the stone carriers, thereby efficiently accommodating the tool to a wide range of cylinder bores while insuring proper grinding pressure. The adjustment mechanism is so arranged that it is unaffected, from the standpoint of accuracy, by the dust, grit, etc., resulting from the grinding operation. Looseness of parts and strains and stresses necessarily imposed on the driving mechanism does not in any way affect the tool adjustment. Disalignment of the drive and the tool, which is compensated for by the universal drive connections, in no way affects the adjustment of the tool. In addition, the tool structure is quite simple and is quite inexpensive to manufacture, all this being attained with a tool affording greatly increased efficiency in the grinding of cylinders, whether they be newly formed or used and worn.

I claim:

1. A cylinder grinding tool comprising a body, grinding devices carried by said body for movement toward and from a cylinder wall to be ground, a member movable relative to said devices to move said devices toward and from the cylinder wall, means for moving said member including an element adjustably mounted directly upon and movable along said member and a compressible spring disposed between said element and said body, said spring being compressible to predetermined and variable extents by adjustment of said element along said member when said grinding devices are engaged with the cylinder wall for automatically expanding said grinding devices as the grinding operation takes place and for determining the unit pressure employed during the grinding operation, and adjustable means adapted to be engaged by said member for limiting the extent of movement of said grinding devices toward the cylinder wall during the grinding operation.

2. A cylinder grinding tool comprising a body, grinding devices carried by said body for movement toward and from a cylinder wall to be ground, a member movable relative to said devices to move said devices toward and from the cylinder wall, means for moving said member including an element adjustably mounted upon and movable along said member and a compressible spring disposed between said element and said body, said spring being compressible to predetermined and variable extents by adjustment of said element along said member when said

grinding devices are engaged with the cylinder wall for automatically expanding said grinding devices as the grinding operation takes place and for determining the unit pressure employed during the grinding operation, and adjustable means for variably determining the extent of adjustment of said grinding devices toward the cylinder wall by said spring.

3. A cylinder grinding tool comprising a body, grinding devices carried by said body for movement toward and from a cylinder wall to be ground, a member movable relative to said devices to move said devices toward and from the cylinder wall, means for moving said member including an element adjustably mounted upon and movable along said member and a compressible spring disposed between said element and said body, said spring being compressible to predetermined and variable extents by adjustment of said element axially along said member, means for indicating the extent of adjustment of said element in terms of unit pressure applied to said grinding devices, and adjustable means for variably determining the extent of adjustment of said grinding devices toward the cylinder wall.

4. A cylinder grinding tool comprising a body, grinding devices carried by said body for movement toward and from a cylinder wall to be ground, a member movable relative to said devices to move said devices toward and from the cylinder wall, means for moving said member including an element adjustably mounted upon and movable along said member and a compressible spring disposed between said element and said body, said spring being compressible to predetermined and variable extents by adjustment of said element along said member, and an adjusting device carried by said body and adjustable to variable extents toward and from said member and adapted to be engaged by said member to stop movement of said grinding devices toward the cylinder wall when the cylinder has been ground to a predetermined extent.

5. A cylinder grinding tool comprising a body, abrasive members mounted in said body for expansion and contraction movements toward and from a cylinder wall to be ground, an expanding device supported in said body for axial movement and having elements engaging said members for expanding the latter, means for shifting said expanding device including a member carried solely by said expanding device and adjustable axially therealong and a compression spring disposed between said member and said body and compressible to variable extents to move said expanding device and abrasive members to variable extents and to cause said abrasive members to engage the cylinder wall under a predetermined selected pressure, and adjustable means adapted to be engaged by said expanding device for limiting the extent of movement of said abrasive members relative to the cylinder wall after they have been initially engaged therewith.

6. A cylinder grinding tool comprising a body, grinding members mounted in said body for expansion and contraction movements toward and from a cylinder wall to be ground, an expanding device supported in said body for axial movement and having elements engaging said members for expanding the latter, means for shifting said expanding device including a member carried solely by said expanding device and adjustable axially therealong and a compression spring disposed between said member and said body and compressible to variable extents to move said expanding device and grinding members to variable extents and to cause said grinding members to engage the cylinder wall under a predetermined selected pressure, means for indicating the pressure under which said grinding members are engaged with the cylinder wall, and means carried by said body and adapted to be adjustably disposed in the axial path of said expanding device for limiting the extent of expansion of said grinding members.

7. A cylinder grinding tool comprising a body, grinding devices mounted in said body and movable toward and from a cylinder wall to be ground, a member rigidly supported on the axis of said body, a second member supported by said first member for axial movement and having elements thereon adapted to engage and move said grinding devices toward the cylinder wall as said second member is moved in one direction, means for moving said second member axially including an element carried by said second member and adjustable therealong, a compression spring confined between said element and said body and compressible when said grinding devices are engaged with the cylinder wall to automatically move said grinding devices toward the cylinder wall and to cause said grinding devices to engage the cylinder wall under a predetermined pressure, and means carried by and adjustable along said first member for engaging said second member to limit the extent to which the cylinder wall may be ground.

8. A cylinder grinding tool comprising a body, grinding members supported by said body for expansion and contraction movements, a member rigidly secured to and extending through the central portion of said body, an expanding member supported by said rigidly secured member and movable axially to expand and contract said grinding members, means for moving said expanding member axially, and means carried by said rigidly secured member for limiting the extent of movement of said expanding member in one direction.

9. A cylinder grinding tool comprising a body, grinding members supported by said body for expansion and contraction movements, a member rigidly secured to and extending through the central portion of said body, an expanding member supported by said rigidly secured member and movable axially to expand and contract said grinding members, means including an axially adjustable element on said expanding element and a spring between said element and said body for moving said expanding member axially, and means carried by said rigidly secured member for limiting the extent of movement of said expanding member in one direction.

10. A cylinder grinding tool comprising a body, grinding members supported by said body for expansion and contraction movements, a member rigidly secured to and extending through the central portion of said body, an expanding member supported by said rigidly secured member and movable axially to expand and contract said grinding members, means including an axially adjustable element on said expanding element and a spring between said element and said body for moving said expanding member axially, said spring being compressible by said element to automatically expand said expanding element as the cylinder is being ground and to exert and maintain a substantially constant grinding pres-

sure, and means carried by said rigidly secured member and adjustable axially therealong for variably limiting the extent of movement of said expanding member in one direction.

11. A cylinder grinding tool comprising a body having a central tubular part rigid therewith and extending axially therethrough and beyond one end thereof, grinding members carried by said body for expansion and contraction movements, a tubular expansion member carried by said tubular part for axial movement and having elements engaging said grinding members to expand and contract the latter as said expansion member is moved axially, means for moving said expansion member axially including an adjustable element on said expansion member and a spring urging said adjustable element in one direction, means for variably limiting the extent of expansion of said grinding members by said expansion member, and drive means extending through said tubular part and having a universal connection therewith.

12. A cylinder grinding tool comprising a body, grinding members mounted in said body for expansion and contraction movements, an expanding member carried by said body and movable axially thereof for expanding and permitting contraction of said grinding members, means for moving said expanding member including an axially adjustable element on said expanding member and a spring confined between said element and said body, indicating means with which said element registers to indicate extent of adjustment of said element in terms of pressure, means for limiting the extent of axial movement of said expanding member in one direction including an axially adjustable member carried by said body, and means for indicating the extent of adjustment of said adjustable member in terms of thickness of material to be removed from a cylinder wall.

13. A cylinder grinding tool comprising a body, grinding members mounted in said body for expansion and contraction movements, an expanding member carried by said body and movable axially thereof to expand and contract said grinding members, means for moving said expanding member including an axially adjustable element on said expanding member and a spring confined between said element and said body, indicating means carried by said body and with which said element registers to indicate extent of adjustment of said element in terms of pressure, means for limiting the extent of axial movement of said expanding member in one direction including an axially adjustable member carried by said body, and means including registering indicating elements on said adjustable element and said adjustable member for indicating the extent of adjustment of said adjustable member in terms of thickness of material to be removed from a cylinder wall.

14. A cylinder grinding tool which comprises a body, grinding members carried by said body, means for expanding and contracting said members, and means for driving said body rotatably which includes a tubular member extending axially through said body and rigidly secured to the lower end thereof, a driving spindle of lesser diameter than said tubular member extending therethrough and therebeyond at one end, and means including a joint giving universal action connecting the other end of said spindle to said body.

15. A cylinder grinding tool which comprises a body, grinding members carried by said body, means for expanding and contracting said members, and means for driving said body rotatably which includes a tubular member rigidly secured at one end to said body and projecting axially through said body and beyond one end thereof, means for rotatably driving said body which includes a spindle of less diameter than and mounted within said tubular member, means affording universal action connecting one end of said spindle to said body, said spindle being of sufficient length to extend through and beyond the projecting end of said tubular member, and universal joint means on said spindle adapted for connection with a driving mechanism.

16. A cylinder grinding tool comprising a body, grinding members mounted in said body for expansion and contraction movements, a tubular member secured to the bottom of said body and extending axially therethrough and therebeyond, an expander device supported by said tubular member for axial slide movement and engaging said grinding members to expand and contract the same as it is moved axially, means for moving said device axially including an adjusting element on said device and a spring between said device and said body, means carried by said tubular member for limiting the axial movement of said device in expanding direction, means for driving the tool rotatably including a spindle of lesser diameter than and extending through said tubular member, and means including a universal joint connecting the lower end of said spindle with the lower end of said tubular member.

17. A cylinder grinding tool comprising a body having spaced apart top and bottom plates, grinding members supported by said plates for movement toward and from a cylinder wall to be ground, a tubular member extending centrally through said plates and rigidly secured to at least one of said plates and extending beyond one of said plates, an expander member supported by said tubular member for axial movement to move said grinding members toward and from the cylinder wall, means for adjusting said expander member axially including an axially adjustable element carried by said expander member and a spring confined between said element and a part of said body, means for limiting the extent of axial adjustment of said expander member in one direction, and driving means independent of both said adjusting means including a spindle universally connected at one end to said tubular member and extending out through the projecting end thereof.

18. In a cylinder grinding tool, a body, abrasive members supported by said body for movement toward and from the wall of the cylinder to be ground, an axially shiftable expander unit carried by said body and adapted to support said abrasive members against movement away from the cylinder wall, spring means engaging said abrasive members and urging the same away from the cylinder wall and into supporting engagement with said expander unit, means for shifting said expander unit axially toward the cylinder wall including an axially adjustable element carried by said expander unit and a compressible spring of greater power than said spring means and disposed between said body and said element, and means carried by said body and adjustable axially thereof to variably limit the extent of axial movement of said expander unit

in a direction to move said abrasive members toward the cylinder wall.

19. A cylinder grinding tool comprising a body having a pair of end plates with radially directed grooves in their facing surfaces, an annular series of posts disposed between said grooves and rigidly connecting said end plates, abrasive carriers having end portions slidably mounted in said grooves and having abrasive support means along their outer edges, an axially shiftable expander unit mounted centrally of said body and engaging the inner edges of said carriers to expand the latter as said unit is shifted in one direction, means for axially shifting said unit, and means for yieldably opposing expansion movement of said carriers and for holding the same seated against said unit which includes a plurality of leaf springs, one for each of said posts, secured intermediate their ends to said posts with their opposite ends extending toward adjacent ones of said carriers, and spring support elements on said carriers inwardly of said abrasive support means for supporting the ends of said springs which are normally under tension tending to yieldably move said carriers inwardly.

20. A cylinder grinding tool comprising a body, grinding members mounted in said body for expansion and contraction movements, a tubular member secured to said body and extending axially therebeyond at one end, an expander device supported by said tubular member for axial slide movement and engaging said grinding members to expand and contract the same as it is moved axially, means for moving said device axially including an adjusting element on said device and a spring between said device and said body, means carried by the projecting end of said tubular member for limiting the axial movement of said device in expanding direction, means for driving the tool rotatably including a spindle of lesser diameter than and extending through said tubular member and means affording universal action connecting one end of said spindle to said body.

21. A cylinder grinding tool comprising a body having spaced apart top and bottom plates, grinding members supported by said plates for movement toward and from a cylinder wall to be ground, a tubular member extending centrally through said plates and rigidly secured to at least one of said plates and extending beyond one of said plates, an expander member supported by said tubular member for axial movement to move said grinding members toward and from the cylinder wall, means for adjusting said expanding member axially including an axially adjustable member carried by said expander member and a spring confined between said element and a part of said body, means for limiting the extent of axial adjustment of said expander member in one direction, and driving means independent of both said adjustment means and including a spindle extending out through the projecting end of said tubular member and drive-connected with the body by means affording universal action.

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