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SIZING DEVICE FOR HONING APPARATUS

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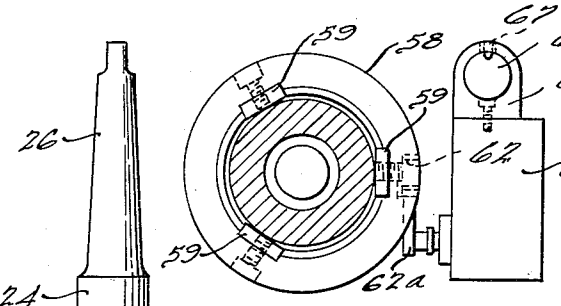


Fig. 3.

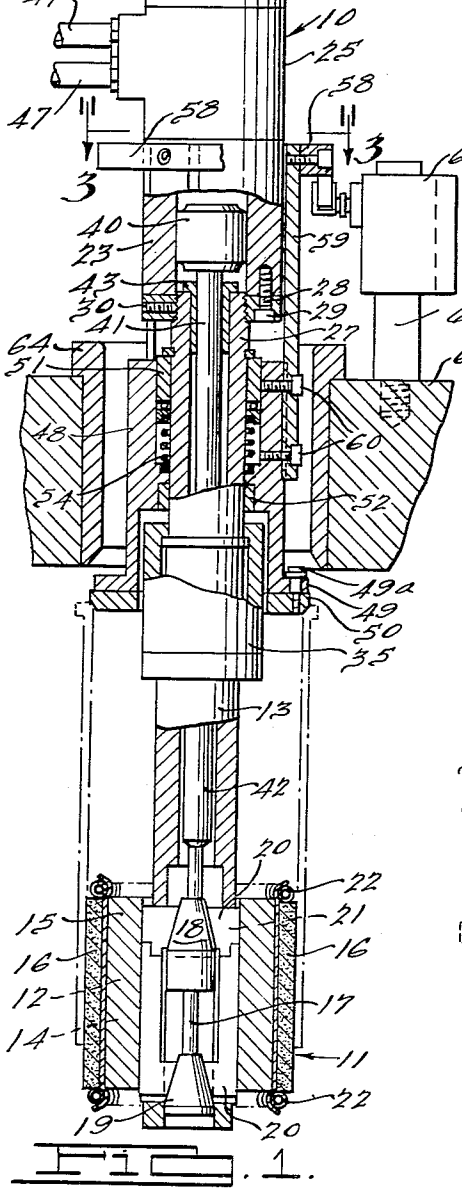


Fig. 1.

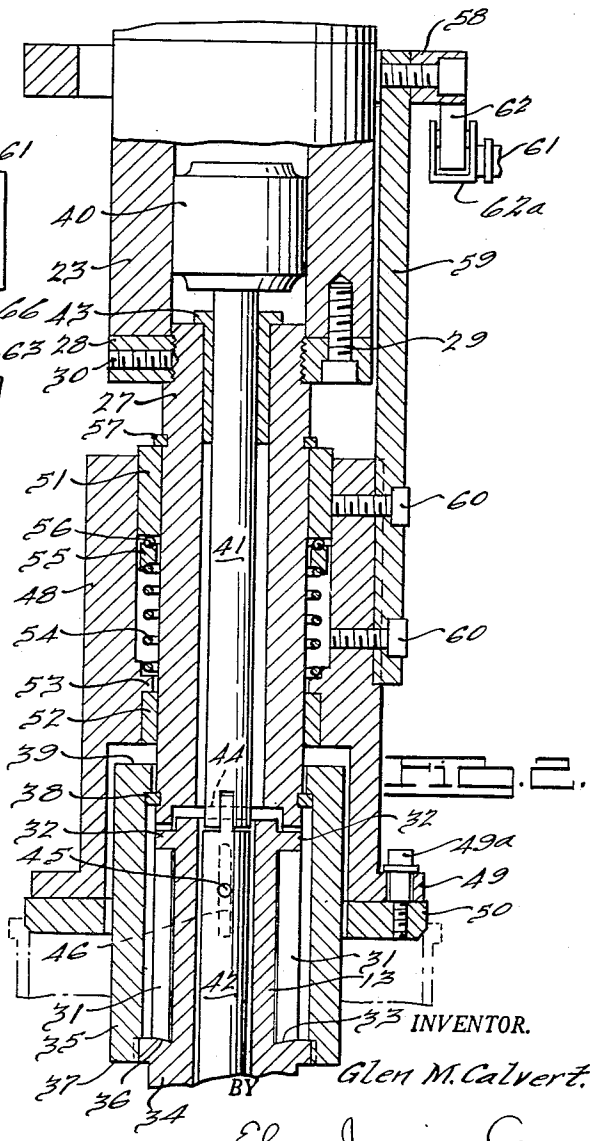


Fig. 2.

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SIZING DEVICE FOR HONING APPARATUS

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11 Claims. (Cl. 51—34)

This invention relates to honing apparatus for honing the bores of workpieces and has for a particular objective thereof the provision of honing devices operated by a reciprocable and rotatable shaft or spindle, gage means encircling or embracing the hone spindle means and acting during operation on the same end of the workpiece bore as the honing devices enter, there being relative axial movement between the gage means and reciprocable shaft during the honing operation, said gage means being axially movable and having a gaging portion or portions entering said end of the workpiece bore in contact therewith when the bore has been honed to a predetermined diameter, and wherein cessation or termination of the honing operation is initiated by a limit switch or control device and means for actuating the same upon predetermined passage of said gage means into the bore including a member secured to the gage means and movable therewith during the honing operation.

By providing herein an apparatus wherein the annular gage support or gage means encircles or embraces the hone spindle or shaft and engages the same end of the workpiece bore that the spindle and honing devices enter, it is possible not only to provide a simplified and compact construction but also to improve materially the control or governing of the sizing of the bore and cessation of the honing operation at the desired times. The gage support or gage means associated with the hone spindle and encircling the same performs two important functions in accordance with the invention, namely, it sizes the bore by contact therewith at the desired stage of the honing operation and at the same time actuates through means carried thereby the limit switch or control device for initiating termination of the honing operation. Moreover, by providing gage and control means arranged with relation to the hone spindle in accordance with the invention a unitary and effective mechanism is provided by which honing to closer tolerances or more accurately to desired dimensions is achieved. It is important to note that the present mechanism enables the spindle to withdraw the gage means from the end of the workpiece during a return stroke thereof while enabling the gage means during the opposite stroke to move into engagement with the end of the workpiece, preferably by spring means acted upon by relatively axially movable means. Of particular importance is the fact that, since the gage means is ineffective to enter operatively the end of the bore until honed to a given size, the control means attached to the gage means is unable to actuate the limit switch or control device to initiate cessation of the honing operation until operative or predetermined entry of the gage means into the bore occurs.

Other objects of this invention will appear in the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

This application is a division of my application Serial No. 212,234, filed February 23, 1951.

Fig. 1 is a fragmentary sectional view of a honing apparatus having the sizing and control means embodied in the present invention mounted thereon.

Fig. 2 is an enlarged longitudinal sectional view of a part of the apparatus shown in Fig. 1, showing particularly the sizing and control means embodied in the present invention.

Fig. 3 is a section taken substantially through lines 3—3 of Fig. 1 looking in the direction of the arrows.

Before explaining in detail the present invention it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

Referring to the drawings wherein there is illustrated, by way of example, a certain embodiment of the present invention, the numeral 10 designates generally a honing device supported in a vertical position and having an abrading head 11 at the lower end thereof. The abrading head 11 may be of any suitable construction having a cylindrical enlargement 12 from which extends upwardly a rotatable shaft or spindle 13. The cylindrical enlargement 12 is formed with a plurality of slots 14 spaced equal distances from one another circumferentially of the enlargement and extending for the full length of the latter. Seated in each slot 14 is a holder 15 extending for the full length of the slot and having its outer surface recessed to receive an abrading element 16.

Supported within the cylindrical enlargement is a cone carrying member 17 having axially spaced cones 18 and 19 concentric with the axis of the abrading head. In accordance with conventional practice, the cones engage shoes 20 slidably supported in slots 21 formed in the cylindrical enlargement 12. The slots 21 are arranged in the enlargment 12 to open into the radially inner sides of the slots 14, so as to enable the shoes to engage the base portions of the holders 15. The shoes are held in bearing engagement with the respective holders 15 by garter springs 22, which respectively encircle projections at opposite ends of the holders.

The above arrangement is such that axial movement of the member 17 in an upward direction simultaneously moves the abrading elements 16 radially outwardly against the surface of the bore within which the abrading head is located. On the other hand, movement of the member 17 in a downward direction permits the springs 22 to contract the abrading head; or in other words, to move the abrading elements 16 radially inwardly.

Referring to Fig. 1 of the drawing, it will be noted that a cylinder 23 is spaced a substantial distance above the abrading head 11 in axial alignment with the latter. In the present instance the cylinder 23 is formed as a part of a spindle 24 which is journalled in a non-rotatable but bodily reciprocable sleeve 25. The upper end 26 of the spindle is adapted for connection to the usual mechanism for rotating the abrasive head 11 and for moving the latter axially relative to the work being honed.

The lower end of the cylinder 23 is closed by the upper end of a tubular spindle member 27 which is threaded into a collar 28 held by screws 29 to the lower end of the cylinder 23. A set screw 30 seated in the collar 28 is provided to lock the collar 28 and the spindle member 27 together to prevent any possibilty of the latter unscrewing from the collar 28 during a honing operation. The spindle member 27 is coaxially arranged with respect to the spindle member 13 on the abrading head 11, and the lower end of the member 27 telescopically receives the upper end of the member 13. As shown in Fig. 2, elon-

gated slots 31 are formed in diametrically opposite sides of the member 27 at the lower end thereof. The slots 31 respectively receive suitable projections or pins 32 which extend radially outwardly from the member 13 at the upper end of the latter, and the slots 31 are open at the lower ends to enable inserting the pins 32 into the same.

The lower end 33 of the spindle member 27 is seated on an annular enlargement 34 formed on the member 13 intermediate the ends of the latter, and the two members are normally held in assembled relation by a coupling sleeve 35. It is to be noted that the lower end 33 of the spindle member 27 has a convex cross section, as best seen in Fig. 2. The annular enlargement 34 is formed with a concave surface 36 adapted to receive the convex end 33 of the spindle member 27. This construction permits the tubular member 13 to move laterally relative to the tubular member 27 thus allowing compensation within limits for any axial misalignment between the axis of the spindle and the axis of the bore being honed. Thus, even if the axis of the spindle and the axis of the bore are slightly misaligned, the abrading head 11 is able to shift laterally so that its axis and the axis of the bore are concentric to ensure that the bore being honed will be formed as a true cylindrical surface. It will be readily understood that the axial misalignment referred to is in the magnitude of thousandths of an inch, it not being intended that axial misalignments of greater magnitude be compensated for by the foregoing construction. The latter type of misalignment would be visible to the eye and therefore readily correctable by adjustment of the work support.

The coupling sleeve 35 is threaded at the lower end 37 on the enlargement 34 and is held in position on the spindle member 27 by a split ring 38. The split ring is engaged in an annular groove formed in the member 27, and provides an abutment for an annular inturned flange 39 formed on the upper end of the coupling sleeve 35. Thus, the cylinder or spindle 24 is removably secured to the abrading head 11 in a manner such that the spindle rotates as a unit with the abrading head.

A piston 40 is supported in the cylinder 23 for sliding movement relative thereto, and is connected to the cone carrying member 17 for actuating the latter to adjust the abrading elements 16. The connection between the piston 40 and cone carrying member 17 comprises a pair of rods 41 and 42. The rod 41 is connected at its upper end to the piston 40, and is slidably supported within the spindle member 27 by a guide bushing 43. The lower end of the rod 42 is secured to or formed integral with the upper end of the member 17, and extends through the tubular member 13. The adjacent or inner ends of the rods are pivotally connected together with a pin 44 having its axis perpendicular to the aligned axes of the rods to enable relative pivotal movement of the rods and thereby compensate for any slight misalignment therebetween. The location of the pivot pin 44 relative to the coupling sleeve 35 and to the slots 31 is such that the pin 44 may be registered with the slots 31 upon detaching the coupling sleeve 35 from the annular part 34 and sliding the coupling sleeve 35 upwardly along the member 27. The pin 44 is then accessible and may be driven out of engagement with the adjacent ends of the rods 41 and 42. Thus, the abrading head assembly 11 may be readily disconnected from or connected to the cylinder or spindle assembly.

Means is provided to ensure that the piston 40 will rotate at all times as a unit with the cylinder 23 and the abrading head 11. As shown in Fig. 2, a pin 45 extends transversely through the rod 42 adjacent the upper end thereof, and the opposite ends of the pin respectively project into elongated slots 46 formed in diametrically opposite sides of the tubular spindle member 13. The length of the slots 46 is determined to permit the necessary extent of sliding movement of the rods relative to the surrounding parts by the piston 40, and the width of the slots is such as to provide for engagement of the projecting ends of the pin 45 with the tubular member 13 to effect rotation of the rods 41 and 42 as well as the piston 40 as a unit with the abrading head 11 and spindle 26.

The piston 40 is moved in opposite directions to correspondingly operate the cone carrying member 17 by alternately exerting air or fluid pressure on the piston 40. The construction and arrangement of the apparatus with regard to the manner in which the fluid or air pressure is directed to the proper side of the piston forms no part of the present invention. It is deemed sufficient to merely state that when fluid under pressure is directed by suitable valve means to the underside of the piston 40 through a system of pipes or tubes 47 connected to fluid passageways in the sleeve 25 and the cylinder 23, the piston moves upwardly in the cylinder 23 causing the cone carrying member 17 to also move upwardly in the abrading head 11 thereby moving the abrading elements 16 radially outwardly. Further manipulation of the valve means directs the fluid pressure to the upper side of the piston 40 and exhausts the fluid from the lower side. Accordingly, the piston 40, together with the cone carrying member 17, is moved downwardly and permits the abrading elements 16 to move radially inwardly under the influence of the garter springs 22.

The operation of the valve means directing the flow of the fluid pressure as well as the operation of the mechanism causing the rotation and reciprocation of the spindle 24 carrying the abrading head are preferably controlled by electrically actuated means as hereinafter described. In accordance with the present invention improved means is provided for continuously gaging the diameter of the bore being honed and for automatically actuating a control means to bring the honing operation to conclusion as soon as the bore has been honed to the proper diameter. In the construction illustrated the sizing and control means includes a cylindrical or tubular gage body 48 encircling or embracing the hone spindle member 27 with the lower end thereof overlying the coupling sleeve 35. The lower end of the gage body 48 has an annular flange 49 thereon to which is fastened by means of screws 49*a* a gaging or sizing ring 50 formed of a wear resistant tool steel. As best seen in Fig. 2, the shoulder on each screw 49*a* is of lesser diameter than the diameter of the holes in the flange 49. This permits the gage ring 50 to float a slight degree laterally to compensate for any slight misalignment of the tool spindle with the bore being honed. The gaging or sizing element 50 is in effect a plug gage having a diameter equal to the diameter desired to be honed in the bore of the workpiece. As will hereinafter be explained, the honing operation will continue until the gaging element 50 is able to enter into the bore of the workpiece.

Referring to Fig. 2 in particular it will be noted that the tubular gage body 48 is journalled on the tubular spindle member 27 by two spaced bushings 51 and 52, preferably made of bronze. It will also be noted that the bore of the tubular gage body 48 is counterbored at its lower end to receive the upper portion of the coupling device 35. The coupling device 35 determines the lowermost position of the tubular gage body 48 relative to the tubular spindle member 27 since its outside diameter is greater than the bore of the gage body. The lower bushing 52 is press fitted into the bore of the tubular body 48 and bottoms against an annular ring 53 projecting inwardly from the bore wall. The annular ring 53 also forms a seat for the lower end of a compression spring 54 which surrounds the tubular spindle member 27. A spring retainer 55 is seated on the upper end of the spring 54 and is grooved on its upper surface to receive a number of small ball bearings 56. The lower surface of the upper bearing 51 is seated on the balls 56. The upper bearing has a slip fit relative to both the gage body 48 and the spindle member 27 but is retained in proper

relation thereto by a retainer ring 57 fitted into a groove in the spindle member 27.

When the abrading head 11 is at the upper portion of the cylinder bore being honed, the gage body 48 carrying the sizing ring 50 is at its lowermost position on the spindle of the honing device. As the abrading head 11 approaches the bottom of the bore being honed, the sizing ring 50 will attempt to enter the bore, as shown in Fig. 1. However, if the bore diameter is too small to permit entry of the sizing ring 50, the tubular gage body 48 will be urged upwardly relative to the spindle member 27 against the resistance of the compression spring 54. The lower bushing 52 slides upwardly with the gage body 48 relatively to the spindle member 27 as the gage body 48 slides over the upper bearing 51 which is fixed against movement relative to the spindle member 27 by the retainer ring 57. The spring 54 is, therefore, compressed between the annular ring 53 and the upper bushing 51, and the range of upward movement of the gage body 48 relative to the spindle 27 being limited by the compressibility of the spring 54.

The ball bearings 56 between the upper surface of the spring retainer 55 and the lower surface of the bushing 51 are for the purpose of substantially eliminating frictional drag on the upper end of the spring 54. It will be apparent that the gage body 48 will be urged to rotate with the honing device 10 until the lower edge of the gaging element 50 bears against the edge walls of the bore of the workpiece. At such time the frictional engagement of the two surfaces will generally be sufficient to substantially eliminate any rotation of the gage body 48. The interposition of the ball bearings 56 between the spring retainer 55 and the lower surface of the bushing 51 ensures that regardless of any relative rotation between the annular ring 53 and the bushing 51 the upper end of the spring will always rotate at substantially the same rate as the lower end.

As the honing operation continues, the diameter of the bore of the workpiece will become sufficiently enlarged so as to permit the gaging ring 50 to enter therein and the tubular gage member 48 will then travel substantially the full down stroke of the honing device. The downward movement of the gage member 48 functions to initiate cessation of the honing operation in the following manner. An annular ring 58 is supported in the present instance on three upstanding limit switch control members 59 fastened to the tubular gage body 48 by means of screws 60. The annular ring 58 is only adapted after entry of the gage ring into the workpiece bore to move into position to contact an anti-friction roller 62 on one end of a swingable actuating finger or lever 62*a* of a limit switch 61 mounted on the frame of the honing apparatus in any convenient place, herein illustrated as mounted on the fixture frame 63 supporting the fixture guide bushing 64. The limit switch 61 has a projecting portion 65 provided with a vertical hole embracing and adjustable vertically on a rod 66 attached to frame 63. The limit switch is held in adjusted position on rod 66 by a set screw 67. It will be noted that the annular contact ring is not able to trip the actuating finger or lever 62*a* until the gaging element 50 is able to enter the bore of the workpiece thereby permitting the tubular gage body 48 to travel the full downward stroke of the honing device 10. When the gaging element enters the bore of the workpiece, which means that the bore has been honed to the desired diameter, the annular contact ring 58 will trip the actuating lever 62*a* which will cause the limit switch to send current into the electrically controlled circuit of the honing apparatus controlling the flow of pressure to the piston 40. The piston 40 will be urged in the direction necessary to collapse the abrading elements 16 and the collapse of the latter will be sequentially followed by the withdrawal of the abrading head 11 from the workpiece.

From the foregoing, it is readily apparent that the present invention provides a simple and effective means for gaging the size of the bore being honed and for automatically actuating the control member, such as a limit switch, which will cause the collapse of the abrading elements of the abrading head and the withdrawal of the abrading head from the bore of the workpiece being honed as soon as the bore has been honed to the desired diameter.

I claim:

1. Honing apparatus comprising a honing tool having mounted thereon a rotatable head having abrading elements positioned to engage a cylindrical surface of a workpiece at points spaced from each other circumferentially of the surface, means supporting the abrading elements on the head for movement relative to the head radially of the axis of the head toward and away from the cylindrical surface, said honing tool together with the head and abrading elements being reciprocable relative to the workpiece, means for rotating the head during reciprocation of the latter to remove excess material from the cylindrical surface, a gage for the cylindrical surface carried by said honing tool for reciprocation therewith but restrained from movement in one direction by the excess material to be removed from the cylindrical surface, means interposed between said honing tool and gage for moving the gage in said one direction relative to the workpiece in response to removal of the excess material from the cylindrical surface by the abrading elements, and means responsive to movement of the gage in said one direction relative to the workpiece operative to stop rotation and reciprocation of the head and to move the abrading elements in a direction away from the surface.

2. Honing apparatus for removing excess material from a surface of a workpiece, comprising a honing tool supported for reciprocation along the surface of the workpiece and having a head mounted thereon carrying abrading elements adapted to engage the surface of the workpiece, means for reciprocating said honing tool together with said head along the surface of the workpiece to remove excess material therefrom, a gage for determining when the workpiece has been finished to the desired size, means mounting said gage on said honing tool for limited movement relative to said honing tool and in the direction of reciprocation of the latter, said gage having a gaging element positioned at one end of the surface for engagement with the excess material to be removed, thereby to restrain said gage against movement in one direction along the surface with said honing tool as the latter moves along the surface, means interposed between said honing tool and gage for moving the latter in said one direction along the surface in response to removal of the excess material from the surface by the abrading elements, and means responsive to movement of said gage in said one direction along the surface of the workpiece operative to stop reciprocation of said honing tool and head.

3. Honing apparatus for removing excess material from a cylindrical surface of a workpiece, comprising a honing tool supported for reciprocation along the cylindrical surface of the workpiece and having a head rotatably mounted thereon carrying abrading elements adapted to engage the cylindrical surface at circumferentially spaced points, said honing tool together with said head being reciprocable along the cylindrical surface of the workpiece, means for rotating said head during reciprocation of the latter to remove the excess material from the cylindrical surface, a gage for determining when the workpiece has been finished to the desired size, means mounting said gage on said honing tool for limited movement relative to said honing tool and in the direction of reciprocation of the latter, said gage having a gaging element positioned at one end of the surface for engagement with the excess material to be removed, thereby to restrain said gage against movement in one direction along the surface with said honing tool as the latter moves along the surface, means interposed between said honing tool and gage for

moving the latter in said one direction along the surface in response to removal of the excess material from the surface by the abrading elements, and means responsive to movement of said gage in said one direction along the surface of the workpiece operative to stop rotation of said head and reciprocation of said honing tool and head.

4. Honing apparatus for removing excess material from the surface of a cylindrical bore in a workpiece, comprising a honing tool supported for reciprocation toward and away from the workpiece and having a head rotatably mounted thereon adapted to project into the bore, said head carrying abrading elements in positions to engage the surface of the bore at circumferentially spaced points, said honing tool together with said head being reciprocable toward and away from the workpiece for movement of said head along the surface of the bore, means for rotating said head during reciprocating of the latter to remove excess material from the surface, a gage for determining when the workpiece has been finished to the desired size, means mounting said gage on said honing tool for limited movement relative to said honing tool and in the direction of reciprocation of the latter, said gage having circumferentially spaced gaging elements thereon positioned at one end of the surface for engagement with the excess material to be removed, thereby to restrain said gage against movement in one direction along the surface with said honing tool as said head moves along the surface, yieldable means interposed between said honing tool and gage for moving the latter in said one direction along the surface in response to removal of the excess material by the abrading elements, and means responsive to movement of said gage in said one direction along the surface of the workpiece operative to stop rotation of said head and reciprocation of said honing tool and head.

5. In a honing apparatus for honing the bore of a tubular workpiece, reciprocable and rotatable spindle means and honing means carried thereby and adapted to enter one end of the workpiece bore, hone actuating means for moving the honing means relative to the workpiece bore including a shiftable rod extending through the spindle means, an annular plug gage device embracing said spindle means and through which the spindle means extends and being mounted to permit relative shiftable movement of the gage device and spindle means axially of the latter, said gage device having a portion operative at said one end of the workpiece bore and having predetermined engagement therewith to prevent operative gage entry into the unfinished bore, said gage device portion having operative entry into the bore in engagement therewith when honed substantially to a predetermined size by the honing means, switch control means for initiating cessation of the honing operation and disposed exteriorly of said spindle means and shiftable rod, and means including a member movable with said gage device for actuating said control means only after said operative entry of said gage device portion into the bore.

6. In a honing apparatus for honing the bore of a tubular workpiece, reciprocable and rotatable spindle means and honing means carried thereby and adapted to enter one end of the workpiece bore, hone actuating means for moving the honing means relative to the workpiece bore including a shiftable rod extending through the spindle means, an annular plug gage device embracing said spindle means and through which the spindle means extends and being mounted to permit relative shiftable movement of the gage device and spindle means axially of the latter, yieldable means for resisting said relative shiftable movement independently of said hone actuating means, said gage device having a portion operative at said one end of the workpiece bore and having predetermined engagement therewith to prevent operative gage entry into the unfinished bore, said gage device portion having operative entry into the bore in engagement therewith when honed substantially to a predetermined size by the honing means, switch control means for initiating cessation of the honing operation and disposed exteriorly of said spindle means and shiftable rod, and means including a member movable with said gage device for actuating said control means only after said operative entry of said gage device portion into the bore.

7. In a honing apparatus for honing the bore of a tubular workpiece having a reciprocable spindle and honing means mounted adjacent one end thereof, a reciprocable annular plug gage device encircling said spindle and through which the spindle extends, means for mounting said gage device for shifting relatively to and axially of the spindle, said gage device having workpiece bore entry means operative at the end of the workpiece bore through which the honing means enters to hone the bore and ineffective during predetermined engagement with said end of the bore to have operative gage entry into the unfinished bore, said gage device means having operative entry into the bore in engagement therewith when the bore is honed to substantially a predetermined size by the honing means, a control device for initiating cessation of the honing operation and disposed free of operative control by said gage device in all positions of the gage device when the latter is prevented from operative gage entry into the unfinished bore, and means for actuating said control device including a member controlled by said gage device and ineffective to cause actuation of the control device until after said operative entry of the gage device means into the bore.

8. In a honing apparatus for honing the bore of a tubular workpiece having a reciprocable spindle and honing means mounted adjacent one end thereof, a reciprocable annular plug gage device encircling said spindle and through which the spindle extends, means for mounting said gage device for shifting relatively to and axially of the spindle, said gage device having workpiece bore entry means operative at the end of the workpiece bore through which the honing means enters to hone the bore and ineffective during predetermined engagement with said end of the bore to have operative gage entry into the unfinished bore, said gage device means having operative entry into the bore in engagement therewith when the bore is honed to substantially a predetermined size by the honing means, switch control means for initiating cessation of the honing operation and disposed exteriorly of the gage device, free of operative control thereby in all positions of the gage device when the latter is prevented from operative gage entry into the unfinished bore, and means controlled by said gage device for actuating said switch control means and only effective to cause actuation of the switch control means after said operative entry of the gage device means into the bore.

9. In a honing apparatus for honing the bore of a tubular workpiece having a reciprocable spindle and honing means mounted adjacent one end thereof, a reciprocable annular plug gage device encircling said spindle and through which the spindle extends, means for mounting said gage device for shifting relatively to and axially of the spindle, said gage device having workpiece bore entry means operative at the end of the workpiece bore through which the honing means enters to hone the bore and ineffective during predetermined engagement with said end of the bore to have operative gage entry into the unfinished bore, said gage device means having operative entry into the bore in engagement therewith when the bore is honed to substantially a predetermined size by the honing means, means for signalling operative entry of the gage device means into the work bore preparatory to initiating cessation of the honing operation and disposed free of operative control by said gage device in all positions of the gage device when the latter is prevented from operative gage entry into the unfinished bore, and means controlled by said gage device for actuating said signalling means after said operative entry of the gage device means into the bore.

10. In a honing apparatus for honing the bore of a

tubular workpiece, reciprocable and rotatable spindle means and honing means carried thereby and adapted to enter one end of the workpiece bore, means for adjusting the honing means laterally relative to the workpiece bore including a shiftable member extending into a bore portion of the spindle means, an annular gage device encircling said spindle means and through which the spindle means extends and being mounted to permit relative shiftable movement of the gage device and spindle means axially of the latter, said gage device having portions operative at said one end of the workpiece bore and having predetermined engagement therewith to prevent operative gage entry into the unfinished bore, said gage device portions having operative entry into the bore in engagement therewith when the bore has been honed substantially to a predetermined size by the honing means, control means operative preparatory to initiating cessation of the honing operation and disposed free of operative control by said annular plug gage device when said gage device portions are prevented from operative gage entry into the unfinished bore, and means controlled by said gage device for actuating said control means only after said operative entry of said gage device portions into the bore.

11. In a honing apparatus for honing the bore of a tubular workpiece, reciprocable and rotatable spindle means and honing means carried thereby and adapted to enter one end of the workpiece bore, means for adjusting the honing means laterally relative to the workpiece bore including a shiftable member extending into a bore portion of the spindle means, an annular gage device encircling said spindle means and through which the spindle means extends and being mounted to permit relative shiftable movement of the gage device and spindle means axially of the latter, yieldable means for resisting said

relative shiftable movement and controlled independently of said hone actuating means, said gage device having portions operative at said one end of the workpiece bore and having predetermined engagement therewith to prevent operative gage entry into the unfinished bore, said gage device portions having operative entry into the bore in engagement therewith when the bore has been honed substantially to a predetermined size by the honing means, control means operative preparatory to initiating cessation of the honing operation and disposed free of operative control by said annular plug gage device when said gage device portions are prevented from operative gage entry into the unfinished bore, and means controlled by said gage device for actuating said control means only after said operative entry of said gage device portions into the bore.

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