Jan. 21, 1958 G. M. CALVERT 2,820,328

SIZING DEVICE FOR HONING APPARATUS

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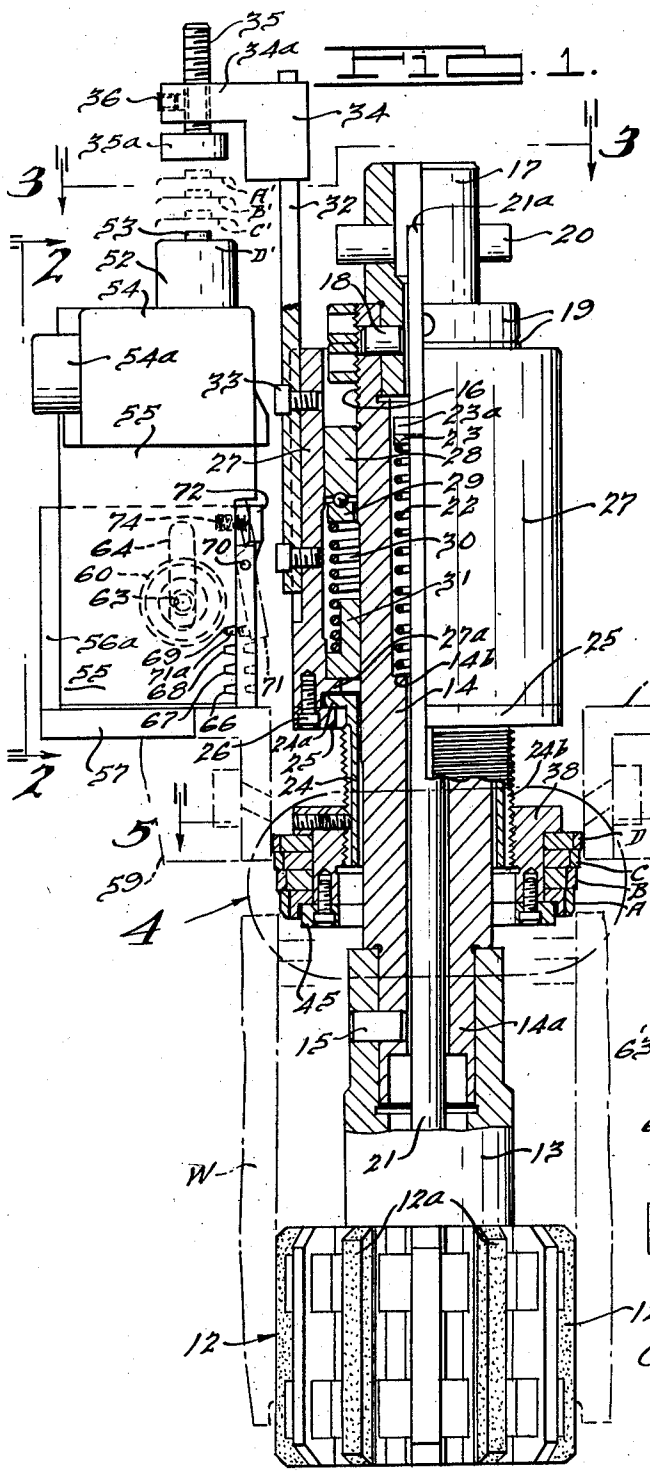


FIG. 1.

FIG. 2.

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SIZING DEVICE FOR HONING APPARATUS

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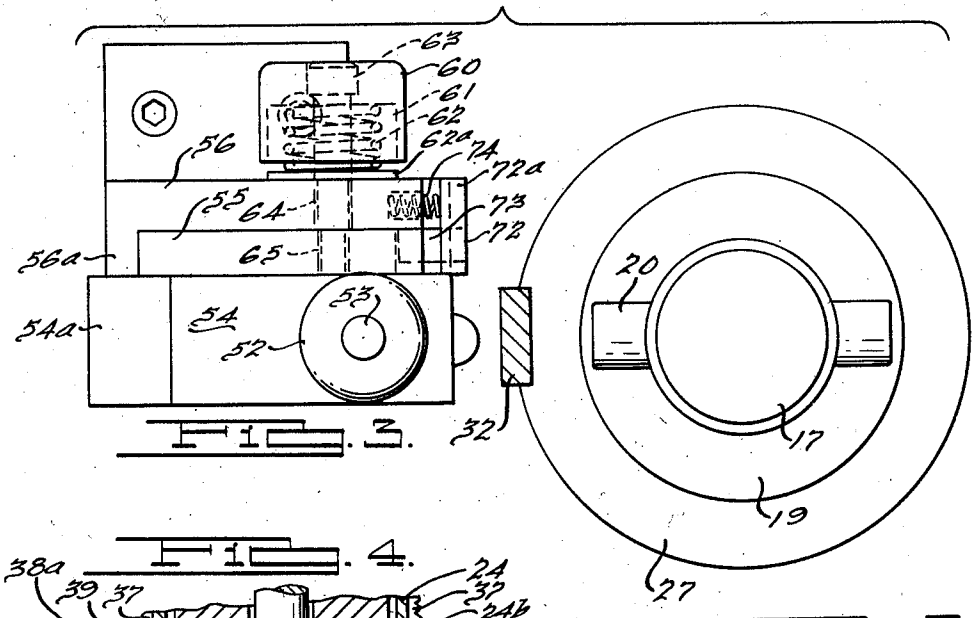


FIG. 3.

FIG. 4.

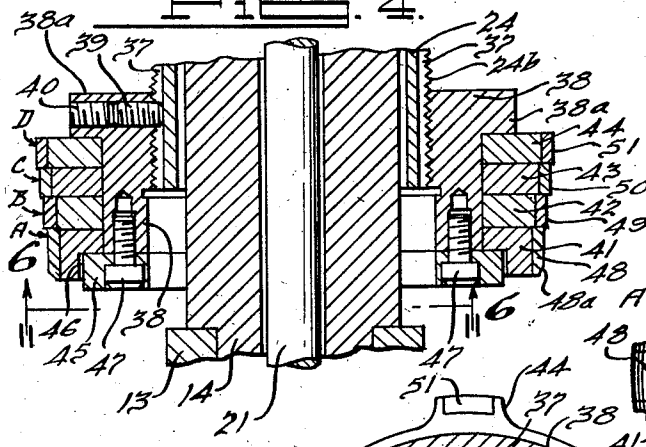
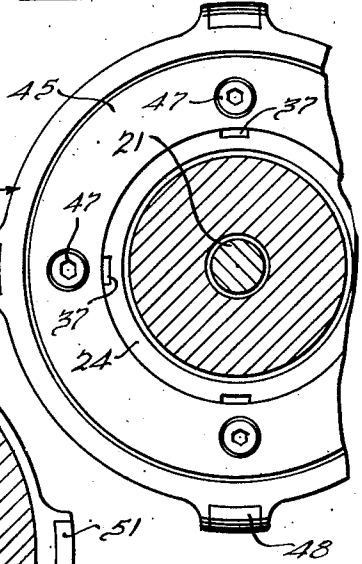


FIG. 6.



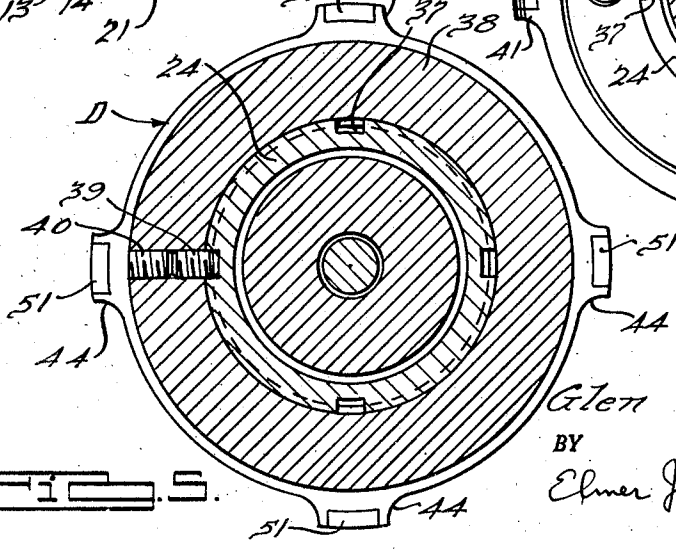


FIG. 5.

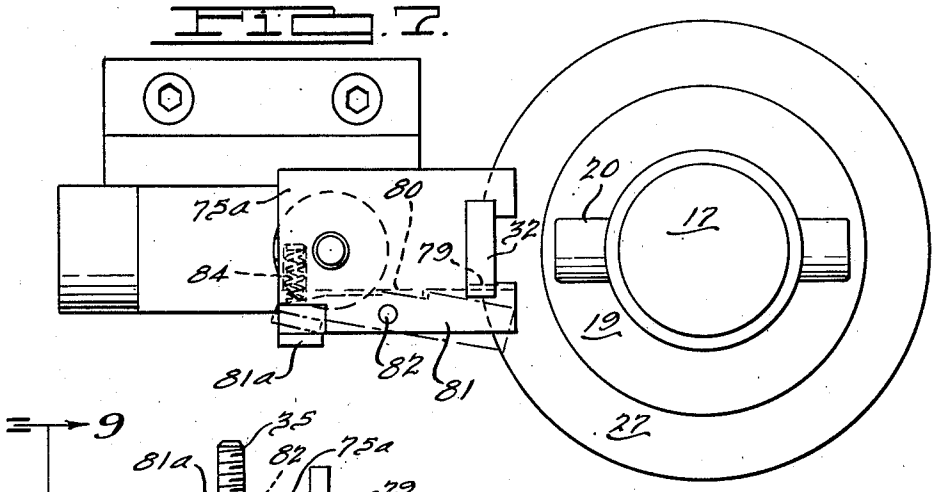
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SIZING DEVICE FOR HONING APPARATUS

Filed July 11, 1956 4 Sheets-Sheet 3

FIG. 2.



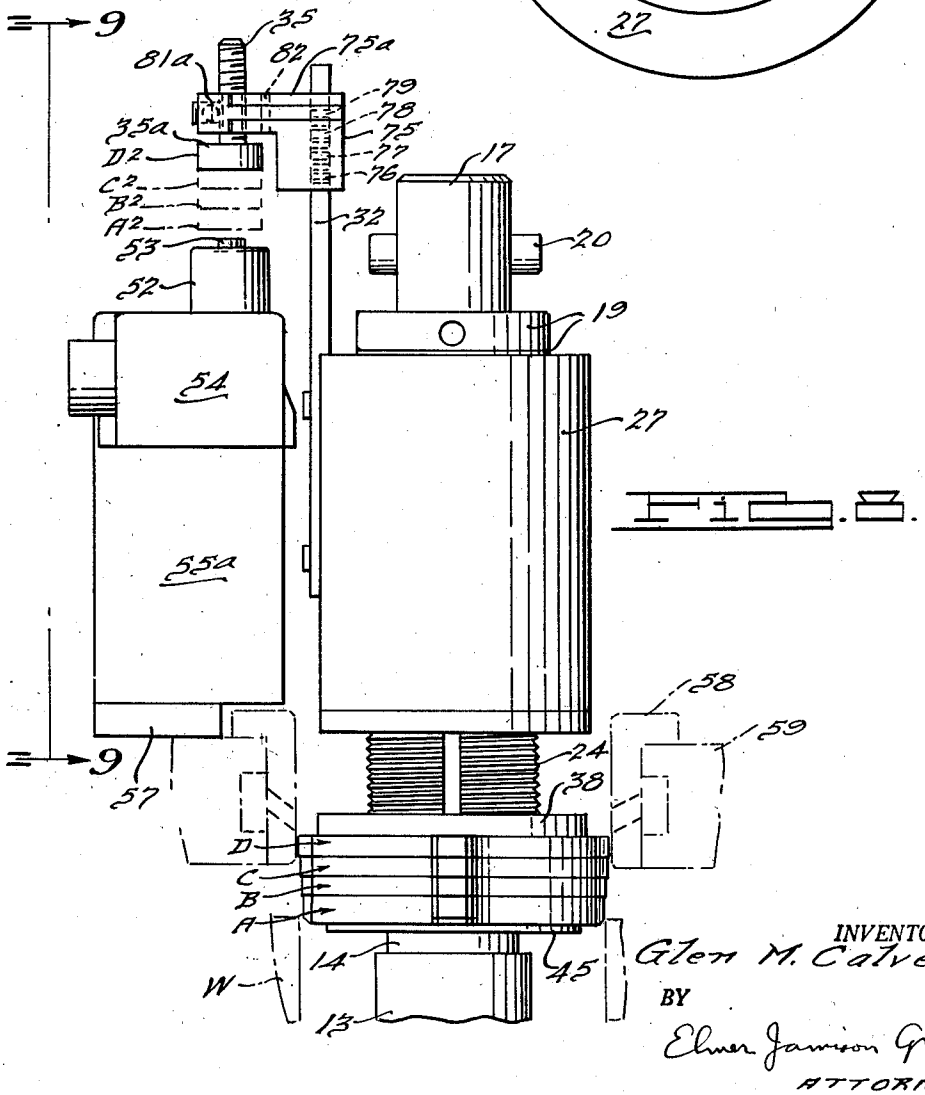


FIG. 1.

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FIG. 9.

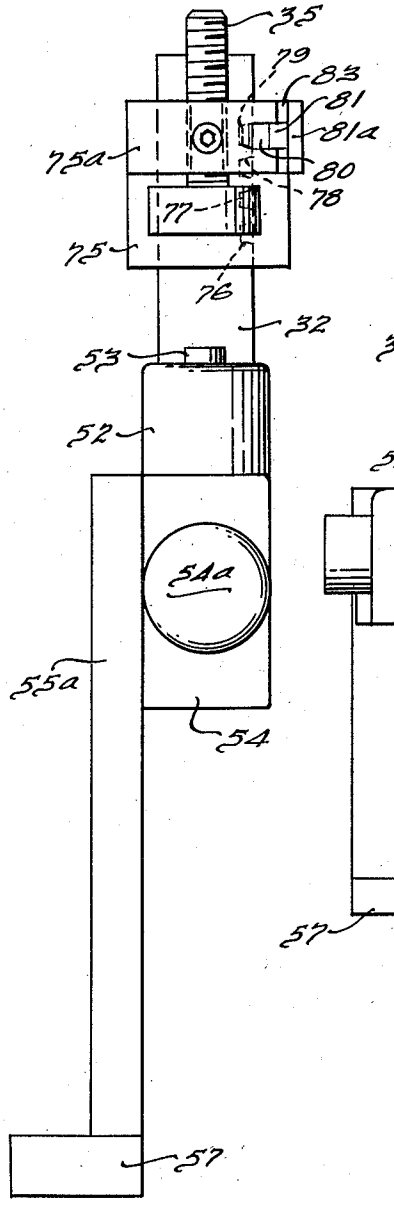
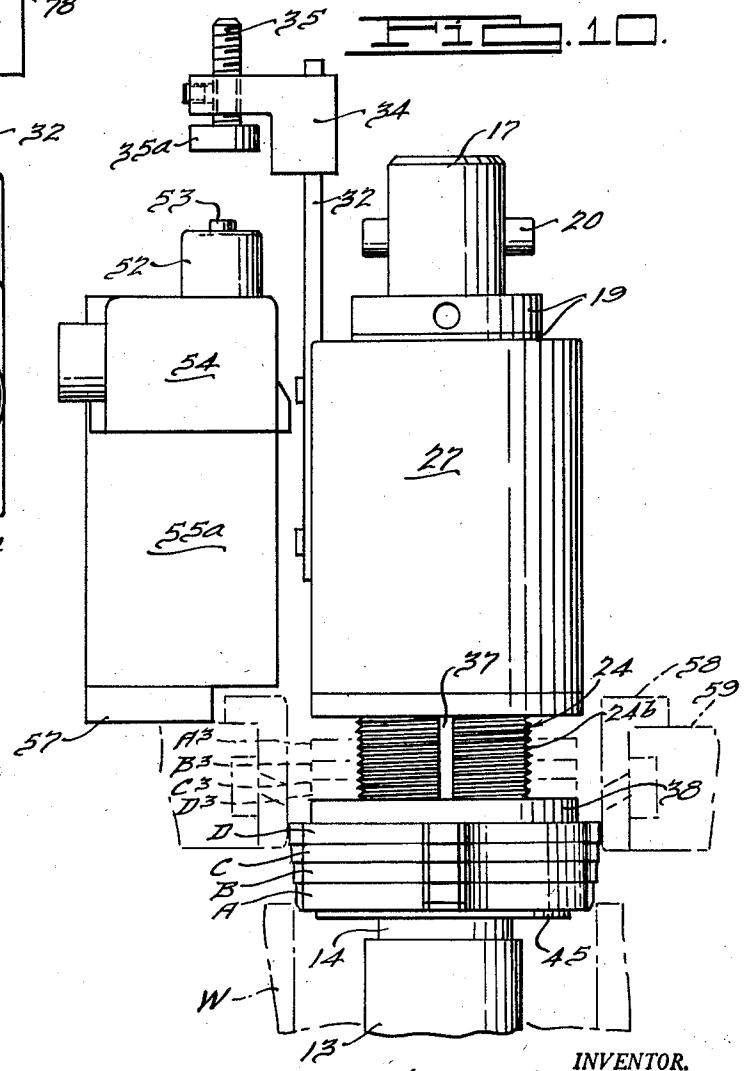


FIG. 10.



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United States Patent Office

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Patented Jan. 21, 1958

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SIZING DEVICE FOR HONING APPARATUS

Glen M. Calvert, Detroit, Mich.

Application July 11, 1956, Serial No. 597,179

13 Claims. (Cl. 51—34)

This invention relates to honing apparatus for honing the bores of workpieces wherein honing devices are operated by a reciprocable shaft or spindle and annular plug gage means encircles or embraces the shaft or spindle and acts during operation on the same end of the workpiece bore as the honing devices enter. In accordance with the operation of such apparatus the gage means is axially movable relative to the shaft or spindle and is adapted to have predetermined operative entry or passage into the workpiece bore when the bore has been honed to a predetermined diameter, such entry or passage of the gage means into the bore resulting in the actuation by the gage means of a limit switch or control device which in turn initiates cessation or termination of the honing operation, the latter being accomplished by releasing the honing devices from honing engagement with the workpiece bore.

An important object of the present invention is to provide gage means having successive portions of varying diameter any one of which may be pre-selected to permit honing of the workpiece bore to the diameter thereof whereupon a limit switch or control device will be actuated to initiate cessation or termination of the honing operation.

A further object of the invention is to provide stepped sizing or gage ring means for controlling the diameter to which the workpiece bore is to be honed, said means preferably comprising a plurality or series of juxtaposed gage rings such, for example, as four thereof. Each gage ring is provided with two pairs of equally and annularly spaced gage elements or portions projecting radially outwardly from the body of the gage ring, the outer effective diameter across each pair of opposed gage elements on each gage ring corresponding to the desired diameter of the finished bore of the workpiece as determined by the pre-selected gage ring. The effective diameters of the series of gage rings progressively increase in such dimensional increments as desired thereby enabling the workpiece bore to be honed to any one of the effective diameters of the series of gage rings whereupon cessation or termination of the honing operation is initiated.

A further object of the invention is to provide stepped diameter sizing or gage ring means, such as above indicated, together with adjustable means for rendering any step of the gage ring means effective at the moment the limit switch or control device is actuated. Such adjustable means may take several different forms. In accordance with the first embodiment of the invention, herein illustrated, there is provided an adjustable limit switch adapted to be actuated at any one of successive positions of adjustment by switch actuating means movable axially in unison with the stepped gage ring means. In accordance with a second embodiment of the invention, herein illustrated, the switch actuating means, which moves axially in unison with the stepped gage ring means, is adjustable relative to the limit switch into any one of successive positions. In accordance with a third embodiment of the invention, herein illustrated, the stepped gage ring means is adjustable axially into any one of successive positions thereby varying the moment of actuation of the limit switch or control device. Thus, in accordance with the several embodiments, the actuation of the limit switch is controlled so as to take effect when any selected step of the gage ring means operatively enters the bore of the workpiece.

Other objects and features 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.

Fig. 1 is a view in elevation and partly in longitudinal mid-section illustrating a honing apparatus constructed in accordance with one embodiment of the present invention.

Fig. 2 is an enlarged side elevation taken in the direction of the arrows from the line 2—2 of Fig. 1.

Fig. 3 is an enlarged plan view, partly in section, taken from the line 3—3 of Fig. 1 looking in the direction of the arrows.

Fig. 4 is an enlarged fragmentary sectional view of the structure bounded by the broken line 4 in Fig. 1.

Fig. 5 is an enlarged transverse sectional view taken in the direction of the arrows along the line 5—5 of Fig. 1.

Fig. 6 is a fragmentary transverse sectional view taken through the line 6—6 of Fig. 4 in the direction of the arrows.

Fig. 7 is an enlarged plan view of a second embodiment of the invention illustrated in Fig. 8.

Fig. 8 is a fragmentary front elevation of the second embodiment of the present invention.

Fig. 9 is a side elevation of the structure shown in Fig. 8 taken in the direction of the arrows from the line 9—9 in Fig. 8.

Fig. 10 is a fragmentary side elevation illustrating a third embodiment of the present invention.

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.

In the drawings there are illustrated three embodiments of a honing tool or apparatus which is attachable at its upper or driven end to the conventional machine spindle. The honing tool, depending upon the type of machine with which it is used, may extend either vertically, or at an angle such as 45° or horizontally. In the present instance the tool is shown in a vertical position, although it is understood that this is merely for illustrative purposes.

In accordance with the present embodiments of the invention the honing tool is provided at its lower end with an abrading head **12** which may be constructed and operated in substantially the same manner as the abrading head in my copending application Serial No. 390,555. The abrading head is carried by a lower enlarged end of a tubular shaft or supporting member **13** which extends upwardly from the abrading head **12**. The honing tool in the present embodiments is provided with a tubular honing tool spindle member **14** formed at its lower end with a reduced cylindrical portion **14a** telescopically received within the upper portion of the tubular shaft or supporting member **13** and secured thereto against relative displacement by a radially extending pin **15**. At its upper end the spindle member **14** is pro-

vided with external threads **16**. A tubular pilot member **17** has a reduced lower portion fitting within the upper end of the spindle **14** and attached thereto through the medium of pin **18**. Threaded onto the upper end of the spindle member **14** are lock nuts **19**. Secured to the pilot member **17** are pins **20** for connecting the pilot member to a hollow spindle coupling which in turn is connected, in accordance with conventional practice, to suitable mechanism for reciprocating and rotating the spindle **14**, shaft member **13** and the abrading or honing tool head **12**.

Extending freely through the tubular spindle member **14** and shaft member **13** is a cone rod **21** connected at its lower end to cone means (not shown) for moving the abrading elements **12***a* radially outwardly against the surface of the bore of the workpiece W within which the abrading head **12** is located, as shown in Fig. 1. In the present instance radial outward movement of the abrading elements **12***a* is accomplished by axial movement of the cone rod **21** in a downward direction. Upon completion of the honing operation the cone rod **21** is shifted in an upward direction thereby enabling the abrading elements **12***a* to be moved radially inwardly free of the work by means of springs (not shown). The foregoing construction is fully illustrated in my above identified application Serial No. 390,555.

The upper end **21***a* of the cone rod **21** is adapted to be contacted by an incremental feed means, such as illustrated in my above identified application. Such feed means progressively forces the cone rod **21** downwardly to cause the cone means at the lower end thereof to expand the abrading elements **12***a* against the bore of the workpiece W. Spring restoring means is provided for shifting the cone rod **21** upwardly when the pressure of the incremental feed means is released, thus permitting the abrading elements **12***a* to move radially inwardly. Upward shiftable movement of the cone rod **21** is accomplished by means of a coil spring **22** having the lower end thereof engaging an annular shoulder **14***b* on the spindle member **14**. The upper end of this spring engages a washer **23** embracing the cone rod **21** and held in position by pins **23***a* secured to the cone rod. Thus, it will be seen that upon release of downward pressure on the cone rod **21** by the incremental feed means the spring **22** will shift the cone rod **21** upwardly thus permitting the abrading elements to collapse.

In addition to the foregoing the honing tool in each of the embodiments is provided with a cylindrical gage ring supporting body **24** terminating at its upper end in an outwardly extending annular flange **24***a*. Underlying the outer portion of this flange is a lock ring or holder **25** attached by means of screws **26** to a cylindrical gage control body **27**. This body is provided with an inwardly extending annular flange **27***a* overlying the flange **24***a* of the gage support **24**. The ring **25** and flange **27***a* are spaced apart to provide an annular channel receiving the gage support end flange **24***a*, such channel having an axial width slightly exceeding the axial thickness of the flange **24***a* thereby permitting the latter to shift laterally or transversely of the spindle **14** without appreciable frictional resistance within the channel. The internal diameter of the cylindrical gage support **24** is appreciably greater than the external diameter of the spindle **14** so as to permit the gage support **24** to shift or float laterally relative to the spindle a substantial amount, such as from ten to thirty thousandths of an inch, depending upon the type of work being honed. This lateral shifting or floating of the gage support **24** is also permitted by the depth of the annular space between the lock ring **25** and flange **27***a* which permits the flange **24***a* of the gage support to shift or float laterally an amount, such as from ten to thirty thousandths of an inch.

Interposed between the cylindrical gage control body **27** and the spindle member **14** is an upper ball race ring **28** which is unconnected and free with respect to the members **14** and **27**. Underlying the ring **28** is a second ball race ring **29** which is also free from connection with the members **14** and **27**. Interposed between ball race rings **28** and **29** are anti-friction ball bearings. A compression spring **30** is interposed between the ball race ring **29** and a bushing **31**. This bushing is free with respect to the spindle member **14** and has the lower end thereof securely press fitted into the cylindrical gage control body **27** so as to have no rotative movement imparted thereto by the spindle member **14**.

A limit switch control member or arm **32** fits within a vertical slot in the gage control body **27**, being attached thereto by means of screws **33**. A trip block **34** is attached to the upper end of the limit switch control member **32**. This strip block is provided with a laterally extending arm **34***a* having a tapped hole for adjustably receiving a limit switch actuating screw **35** terminating in an annular head **35***a* for engaging and actuating the limit switch. The adjusting screw **35** is held in adjusted position by means of a lock screw **36**.

The cylindrical laterally floating gage support **24** is formed with external threads **24***b* and, as particularly shown in Figs. 4 and 5, is formed with four equally spaced vertical slots **37**. A tubular gage holder **38** is provided with internal threads in threaded engagement with the threads **24***b* on the gage support **24**. The gage holder **38** through its threaded connection with the gage support **24** is vertically adjustable thereon. The gage holder **38** is formed with an upper outwardly projecting annular flange **38***a* having a tapped hole to receive a set screw **39** and a lock screw **40**, see Figs. 4 and 5. The gage holder, when adjusted axially on the gage support **24** through its threaded connection therewith, is positioned after adjustment so that the set screw **39** may project into any one of the four anchoring slots **37** thereby holding the gage holder and gage support against relative annular displacement.

Mounted upon and embracing the tubular gage holder **38** and below the annular flange **38***a* thereof are a series of gage rings, four thereof being illustrated by way of example in the present embodiments of the invention. From the lower to the upper thereof these gage rings are designated A, B, C and D and are positioned in snug surface engagement one with another. In preferred practice the gage rings are fabricated separately although they could be embodied integrally in a unit. The gage rings are held in contact relation, with the upper gage ring D in firm engagement with the flange **38***a*, by means of a gage holding ring **45** which projects into an annular notch or groove **46** in the lower gage ring A. The ring **45** is secured to the gage holder **38** by means of four holding screws **47** which may be firmly tightened so as to hold or clamp the gage rings together between the clamping ring **45** and the shoulder **38***a* on the gage holder **38**.

As illustrated in Fig. 5, the gage ring D is formed with two pairs of oppositely disposed protuberances or projecting portions **44**, each having a slot or notch to receive a hard wear insert **51**. These wear inserts are preferably formed of carbide or other wear resisting alloy. The outer surfaces of the wear inserts **51** and the adjacent surfaces of the projections **44** are machined to provide arcuate gaging or sizing surfaces of effective diameter. The gage rings A, B and C are provided, respectively, with two pairs of oppositely disposed protuberances or projections **41**, **42** and **43** which are similar to the projections **44**. The projections in each of the gage rings A, B and C are slotted or notched to receive hard wear inserts **48**, **49** and **50**, respectively. The construction of the four gage rings A, B, C and D with their hard wear inserts is the same and as illustrated in Figs. 5 and 6. However, it will be noted from Figs. 4 and 6 that the projections **44** of the gage ring D extend radially and outwardly slightly beyond the projections **43** of the

gage ring C. In like manner, these projections 43 extend radially and outwardly slightly beyond the projections 42 of the gage ring B. These latter projections also extend radially and outwardly slightly beyond the projections 41 of the gage ring A. This stepped construction of the gage ring projections of the four gage rings provides for entry of the gage rings into bores honed to slightly different diameters. Hence, it follows that the honing operation may be terminated through the medium of control means, such as a limit switch, effective upon operative entry of any one of the gage rings A–D into the honed bore. The four gage projections or gage elements 41 together with their wear inserts 48 terminate in tapering lead portions or cam means 48*a* which progressively narrow in effective diameter and are adapted to displace or cam the gage rings laterally due to the lateral float mounting of gage support 24 thereby centering the gage rings axially with the bore of the workpiece.

In the embodiment of Figs. 1 to 6 inclusive the feed means, which may be hydraulic or other suitable mechanism, for shifting the cone rod or shaft 21, is controlled by an adjustable limit switch generally indicated at 52 having a switch actuating member 53 adapted to be engaged by member 35*a*. The limit switch 52 is carried by a supporting member 54 having a projecting knob 54*a*. This supporting member is attached to a vertically adjustable slide 55 shiftably mounted on a stationary guide bracket 56 having an angle flange 56*a* providing a guide abutment for one vertical edge of the slide. The guide bracket 56, see Fig. 2, is attached to a stationary bracket 57 by screws 57*a*, this bracket being attached to and carried by a stationary fixture bushing 58 (Fig. 1) secured to a fixture frame 59. It will be understood that the central vertical opening through the bushing 58 permits free vertical passage therethrough of the honing tool.

As shown particularly in Figs. 2 and 3, there is provided a spring retainer 60 having a recess 61 within which extends a compression spring 62 disposed between the bottom of the recess and a washer 62*a* slidably engaging the outer face of the bracket 56. The spring retainer 60 is adjustably held by the head of a shoulder screw 63 having its threaded shank extending through and slidable within a vertical slot 64 in guide bracket 56. The end of the shank of screw 63 is threaded at 65 into a tapped hole in the slide 55. By virtue of this construction the slide 55 is yieldingly held in proper vertically adjusted position with respect to the guide bracket 56.

The free vertical edge of the slide 55 is provided with a series of four vertically spaced latching notches 66, 67, 68 and 69. Adjacent the edge of the limit switch adjusting slide 55 is a selector lever pivoted at 70 to the bracket 56. This lever has a downwardly extending lever arm 71 provided with a projecting locking lug or detent 71*a* adapted to project into any one of the notches 66–69 so as to hold the slide 55 in vertically adjusted position. Extending upwardly from the pivot 70 is a lever arm 72 (Fig. 3) which is offset outwardly from the edge of slide 55 to provide a working space 73 permitting the lever arm to be finger pressed inwardly to disengage the locking lug or detent 71*a* from any one of the notches 66–69, as shown in the broken line position of lever arm 71 in Fig. 1. The offset lever arm 72 is formed with a lateral extension 72*a* (Fig. 3) engaged by a small spring 74 seated in a recess in the bracket 56. This spring yieldingly holds the selector lever arm 71 in latching position with respect to slide 55, being compressed upon pressing the lever arm 72 inwardly.

It will be apparent that vertical adjustments of the slide 55 will result in positioning the limit switch 52, 53 in corresponding vertically adjusted positions with respect to the limit switch actuating member 35*a* or, in other words, at variably selected distances from the actuating member. These adjusted positions of the limit switch are indicated at A′, B′, C′ and D′ in Fig. 1 which are determined by latching the slide 55 in the latching notches 66 to 69, respectively. With the limit switch adjustably set at position A′ the honing operation will be terminated after operative entry of gage ring A into the workpiece bore. When set at position B′ the honing operation will continue until gage ring B operatively enters the bore. With the limit switch set at position C′ the honing operation will continue until gage ring C operatively enters the bore. At position D′ of the limit switch, which is furthest from the actuating member 35*a*, the honing operation will not terminate until after the workpiece bore is honed to a size permitting operative entry of gage ring D into the bore. From the foregoing it will be seen that by virtue of the stepped gage means and the adjustable positions of the limit switch the bore of the workpiece may be honed to any one of the diameters of the stepped gages whereupon the limit switch will be actuated to initiate termination of the honing operation.

In the second embodiment of the invention illustrated in Figs. 7 to 9 inclusive the limit switch 52, 53 is not mounted for vertical adjustment. Instead and as distinguished from the first embodiment, the switch actuating means, which moves axially in unison with the stepped gage ring means, is adjustable relative to the limit switch into any one of four selected positions whereby the honing operation will terminate after operative entry of any one of the gage rings A, B, C and D into the workpiece bore.

Referring to Figs. 7 to 9 inclusive, the limit switch 52 and switch actuating member 53 are carried by supporting member 54 which is attached to a stationary vertical member 55*a* secured at its lower end to the bracket 57. In this embodiment the trip block 75, as distinguished from the trip block 34 in the first embodiment, is mounted for vertical adjustment on the limit switch control member or arm 32 thereby enabling the limit switch actuating member 35*a* to be adjustably positioned at variably selected distances from the limit switch, such adjusted positions being indicated at A^2, B^2, C^2 and D^2 in Fig. 8. The control member 32 is provided with four notches 76, 77, 78 and 79 spaced apart similarly to the notches 66–69 in the first embodiment. The trip block 75 and its arm extension 75*a* are provided with a horizontal slot 80 which receives a selector locking lever or latch member 81 pivoted at 82 to the arm extension 75*a*. This locking lever at one side of its pivot may be disposed in any one of the notches 76–79 thereby locking the trip block 75 in adjusted position on the control member 32. The locking lever at the opposite side of its pivot is offset outwardly in the slot 80, see Fig. 9, and terminates in an enlarged finger piece 81*a* which is spaced at 83 from the trip block arm extension 75*a* thereby enabling the finger piece 81*a* to be pressed inwardly to disengage the locking lever from any one of the notches 76–79. The finger piece 81*a* is engaged by a small spring 84 (Fig. 7) seated in a hole drilled in the arm extension 75*a*. This spring yieldingly holds the locking lever 81 in latching position in any one of the notches in the control member 32.

From the foregoing it will be apparent that the latching of trip block 75 in the notches 76–79 will result in adjustably disposing the switch actuating member 35*a* respectively at positions A^2, B^2, C^2 and D^2. With the switch actuating member adjustably set at position A^2 the honing operation will be terminated upon operative entry of gage ring A into the workpiece bore. Likewise when the switch actuating member is adjustably set at position B^2, position C^2 or position D^2, the honing operation will be terminated upon operative entry respectively of gage ring B, C or D into the workpiece bore.

In the third embodiment of the invention illustrated in Fig. 10 the stepped gage ring means is adjustable axially as a unit into any one of four selected positions whereby the honing operation will terminate after operative entry of any one of the gage rings A, B, C and D into the workpiece bore. As described in connection with the first embodiment the gage rings A, B, C and D are securely clamped in position on tubular gage holder 38 which is

provided with internal threads in threaded engagement with the threads 24*b* on the gage support 24. By virtue of this threaded connection the gage hoder 38 may be adjusted axially into four positions indicated at A^3, B^3, C^3 and D^3 thereby varying the time of engagement of switch actuating member 35*a* with limit switch 53. With the gage holder 38 adjusted to position A^3 the switch actuating member 35*a* will engage and actuate the limit switch upon operative entry of gage ring A into the workpiece bore. When adjusted to position B^3 the limit switch 53 will be actuated upon honing the bore to a size permitting operative entry of gage ring B into the bore. With the gage holder adjusted to position C^3 the limit switch will be actuated upon operative entry of gage ring C into the bore. When the gage holder is adjusted to position D^3 the limit switch will be actuated upon honing the bore to a size permitting operative entry of gage ring D into the bore.

In order to ensure accurate axial adjustment of the gage holder 38 into any one of positions A^3–D^3, the bottoms of the slots 37 in gage support 24 may be provided with locating marks for positioning the upper face of the gage holder. With respect to the third embodiment it will be understood that the limit switch 52, 53 is not mounted for vertical adjustment as in the first embodiment nor is the trip block mounted for adjustment on control member 32 as in the second embodiment.

Although in the several embodiments illustrated four varying diameter gage rings A, B, C and D are provided, it will be understood that the number of gage rings may be increased or decreased. The effective diameters of the series of gage rings may vary in dimensional increments of one half a thousandth of an inch or in larger increments enabling the honing of bores to effective diameters having an over-all variation of two or more thousandths of an inch. The invention thus enables different diameter bores to be honed, or bores to be honed to different diameters, merely by making simple adjustments as herein illustrated, thereby effecting important savings in time previously required in removing and dismantling the tool in order to change gage rings so as to accomplish the results achieved by the present invention.

I claim:

1. In a honing apparatus for honing the bore of a tubular workpiece having reciprocable and rotatable spindle means and honing means mounted adjacent one end thereof, a reciprocable annular plug gage unit encircling said spindle means and operative at the end of the workpiece bore through which the honing means enters to hone said bore, said gage unit comprising a series of juxtaposed gage rings having annularly spaced radially projecting gaging portions increasing in effective diameter in the direction away from the honing means, and means effective to initiate cessation of the honing operation upon predetermined operative entry into the workpiece bore of the gaging portions of any one of said gage rings.

2. In a honing apparatus for honing the bore of a tubular workpiece having reciprocable and rotatable spindle means and honing means mounted adjacent one end thereof, a reciprocable annular plug gage unit encircling said spindle means and operative at the end of the workpiece bore through which the honing means enters to hone said bore, said gage unit comprising a series of juxtaposed gage rings having annularly spaced radially projecting gaging portions increasing in effective diameter in the direction away from the honing means, and means for pre-selecting any one of said gage rings to initiate termination of the honing operation upon operative entry of such pre-selected gage ring into the workpiece bore.

3. In a honing apparatus for honing the bore of a tubular workpiece having reciprocable and rotatable spindle means and honing means mounted adjacent one end thereof, a reciprocable annular plug gage unit encircling said spindle means and operative at the end of the workpiece bore through which the honing means enters to hone said bore, said gage unit comprising successive stepped gage ring means increasing in one direction in effective diameter for selectively controlling the effective diameter to which the workpiece bore is to be honed, switch control means for initiating termination of the honing operation by releasing the honing means from honing engagement with the workpiece bore, actuating means movable in unison with said gage unit for actuating said switch control means, and means adjustable in a direction parallel to the axis of said spindle means for varying actuation of said switch control means by said actuating means to correspond to operative entry of any one of said stepped gage ring means into the workpiece bore.

4. Honing apparatus according to claim 3 wherein said adjustable means comprises means for adjusting the position of said switch control means relative to said actuating means.

5. Honing apparatus according to claim 3 wherein said adjustable means comprises means for adjusting the position of said actuating means relative to said switch control means.

6. Honing apparatus according to claim 3 wherein said adjustable means comprises means for adjusting axially the position of said gage unit relative to said switch control means and actuating means.

7. Honing apparatus according to claim 3 wherein said adjustable means comprises means adapted to be adjusted to vary the relative positions of said switch control means and actuating means.

8. In a honing apparatus for honing the bore of a tubular workpiece having reciprocable and rotatable spindle means and honing means mounted adjacent one end thereof, a reciprocable annular plug gage unit encircling said spindle means and operative at the end of the workpiece bore through which the honing means enters to hone said bore, said gage unit comprising a plurality of stepped gage portions successively varying in effective diameter, and means for initiating cessation of the honing operation upon operative entry into the workpiece bore of any pre-selected diametrical step portion of said gage unit.

9. Honing apparatus according to claim 8 comprising means for mounting said gage unit for limited but substantially free movement transversely of the spindle means an amount equal to ten thousandths of an inch or more.

10. In a honing apparatus for honing the bore of a tubular workpiece having reciprocable and rotatable spindle means and honing means mounted adjacent one end thereof, a reciprocable annular plug gage unit encircling said spindle means and operative at the end of the workpiece bore through which the honing means enters to hone said bore, said gage unit comprising successive stepped gage ring means increasing in effective diameter in the direction away from the honing means for selectively controlling the effective diameter to which the workpiece bore is to be honed, switch control means for initiating termination of the honing operation by releasing the honing means from honing engagement with the workpiece bore, actuating means movable in unison with said gage unit for actuating said switch control means, and means adjustable in a direction parallel to the axis of said spindle means for varying actuating of said switch control means by said actuating means to correspond to operative entry of any one of said stepped gage ring means into the workpiece bore.

11. Honing apparatus according to claim 1 comprising means for mounting said gage unit for limited but substantially free movement transversely of the spindle means an amount equal to ten thousandths of an inch or more.

12. In a honing apparatus for honing the bore of a tubular workpiece having reciprocable and rotatable spindle means and honing means mounted adjacent one end thereof, a reciprocable annular plug gage unit encircling said spindle means and operative at the end of the work-

piece bore through which the honing means enters to hone said bore, said gage unit comprising gage ring means having a plurality of gaging portions successively varying in effective diameter, switch control means adapted to be actuated for initiating cessation of the honing operation, actuating means movable in unison with said gage unit for actuating said switch control means, and adjustable means for varying actuation of said switch control means by said actuating means to correspond to operative entry of any one of said portions of said gage ring means into the workpiece bore, said adjustable means comprising means for adjusting the position of said switch control means relative to said actuating means.

13. In a honing apparatus for honing the bore of a tubular workpiece having reciprocable and rotatable spindle means and honing means mounted adjacent one end thereof, a reciprocable annular plug gage unit encircling said spindle means and operative at the end of the work-

piece bore through which the honing means enters to hone said bore, said gage unit comprising gage ring means having a plurality of gaging portions successively varying in effective diameter, switch control means adapted to be actuated for initiating cessation of the honing operation, actuating means movable in unison with said gage unit for actuating said switch control means, and adjustable means for varying actuation of said switch control means by said actuating means to correspond to operative entry of any one of said portions of said gage ring means into the workpiece bore, said adjustable means comprising means for adjusting axially the position of said gage unit relative to said switch control means and actuating means.

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