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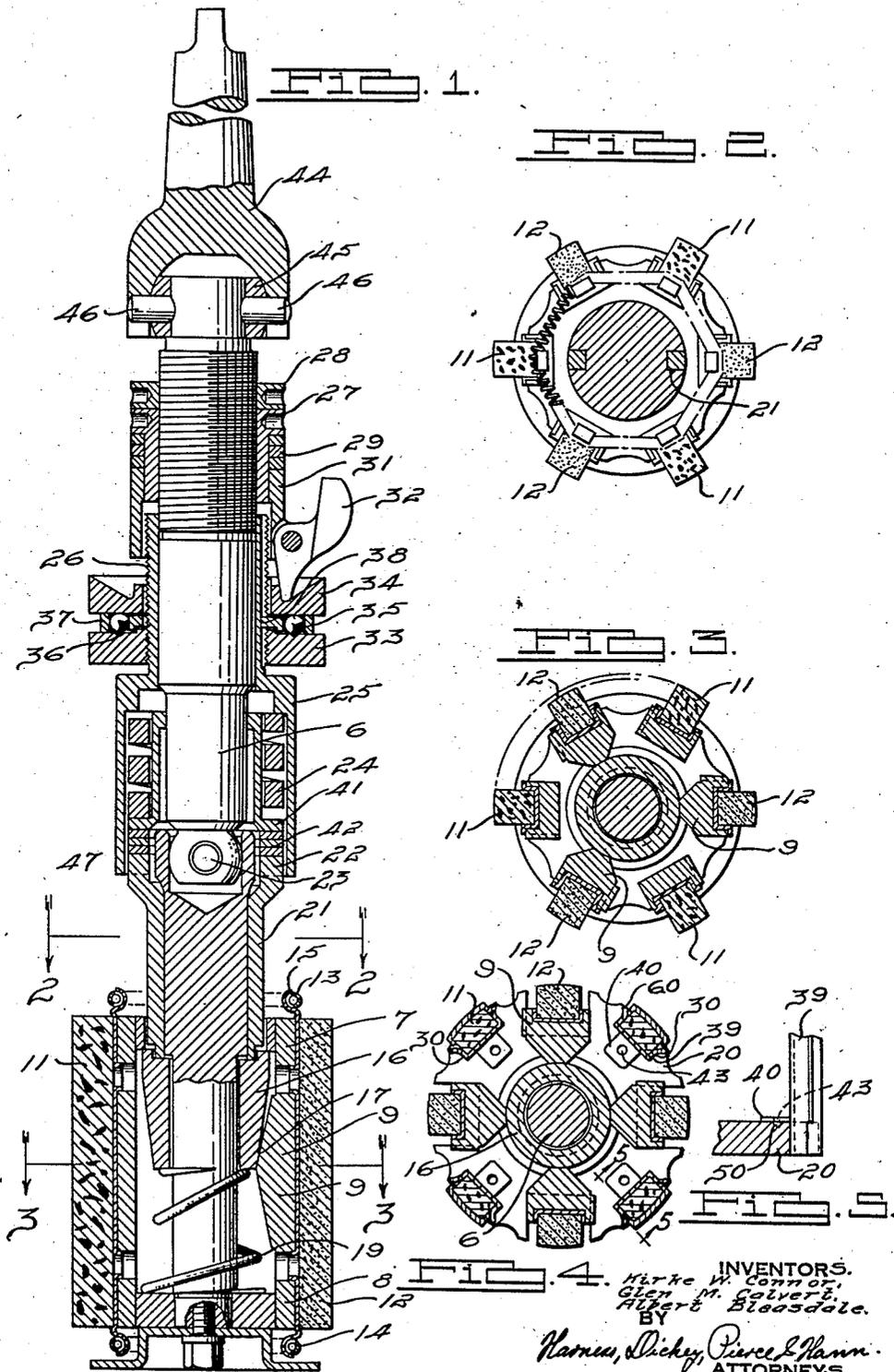
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HONING TOOL

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2,070,985

HONING TOOL

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16 Claims. (Cl. 51—184.2)

Our invention relates to honing tools and particularly to a cylinder honing tool which may be operated at high speed and which may be inserted within and removed from a cylinder without the necessity of changing the speed of rotation of the tool when the tool is advanced or withdrawn from the cylinder.

Actual experiment has disclosed the desirability of actuating a honing tool at high speed so as to produce rapid cutting and a high degree of finish to the cylinder wall. Difficulty has been experienced when attempting to employ higher speeds for honing tools because of the effect of the centrifugal force which whips the tool through a conical path relative to the universal joints of the tool, to cause the collapsed abrading elements to contact with the cylinder wall and to mar its finish. When we speak of high speed we mean speed greater than 300 R. P. M. and find that for most satisfactory honing speeds in the order of 700 R. P. M. or more are desirable.

In practicing our invention we retain the universal movement provided in the longitudinal dimension of the honing tool and employ guide elements of resilient material, such as cork, felt and the like, which are mounted relative to the abrading elements of the tool in a predetermined manner so as to extend beyond the maximum adjustable position of the elements to thereby engage the cylinder wall at all times and especially when the honing elements are in collapsed position. The guiding elements are mounted in fixed relation to the spindle, that is to say, they are not adjustable in the same manner as the honing elements are adjustable laterally of the spindle, so that the collapsing of the honing elements will occur without in any way affecting the position of the guiding elements.

Claims to the improved method disclosed herein are being presented in the applicants' co-pending application Serial No. 89,636 filed July 8, 1936, as a division of this application.

Accordingly, the main objects of our invention are; to provide a honing tool with adjustable honing elements which are collapsible relative to the spindle of the tool; to provide a spindle for the honing tool which is universally jointed so that the honing elements may conform to the bore of the cylinder irrespective of the angular relation therewith of the driving element of the tool; to provide guiding members for the abrading elements which are positioned relative thereto and mounted in fixed relation to the spindle; to provide guiding members which are made of non-abrading material such as cork, felt

and the like, which extend beyond the collapsed position of the honing elements to be available to position the spindle relative to the bore after the honing elements have been collapsed; to provide a strip of material on the cylinder engaging portion of the guiding element, made of fiber, metal, or the like, to permit the movement of the element into and out of a cylinder and an adjacent guiding sleeve in such manner as to prevent wear to the resilient material; and, in general, to provide a honing tool which is constructed in such manner as to permit the tool to be operated at high speed and to be insertable and withdrawable from a cylinder bore without reducing the speed in the tool and without in any way marring the finish of the cylinder wall.

Other objects and features of novelty of our invention will be either specifically pointed out or will become apparent when referring, for a better understanding of our invention, to the following description in conjunction with the accompanying drawings, wherein:

Figure 1 is a sectional view, in elevation, of a honing tool embodying features of our invention.

Fig. 2 is a sectional view of the structure illustrated in Fig. 1, taken on the line 2—2 thereof;

Fig. 3 is a sectional view of the structure illustrated in Fig. 1, taken on the line 3—3 thereof.

Fig. 4 is a view of structure, similar to that illustrated in Fig. 3 showing a modified form thereof,

Fig. 5 is a sectional view of the structure illustrated in Fig. 4 taken on the line 5—5 thereof,

Fig. 6 is a view, partly in section and partly in elevation, of a machine employing the tool illustrated in Fig. 2,

Fig. 7 is an enlarged sectional view of a resilient guiding element showing a modified form thereof,

Fig. 8 is a sectional view of a guiding element similar to that illustrated in Fig. 7, showing a further modified form thereof,

Fig. 9 is a broken elevational view of the structure illustrated in Fig. 8,

Fig. 10 is a broken view, in elevation, of a tool similar to that of Fig. 1, illustrating a modified form thereof,

Fig. 11 is a sectional view of the structure illustrated in Fig. 10, taken on the line 11—11 thereof, and

Fig. 12 is a sectional view of the structure illustrated in Fig. 10, taken on the line 12—12 thereof.

While our invention is applicable to any type of honing tool having collapsible features, we

have illustrated and are about to describe a preferred form of honing tool which is especially adaptable for high speed continuous operation.

In Fig. 1, we have illustrated a honing tool 5 which is similar in construction to the honing tool described and claimed in Patent No. 1,990,331, granted February 5, 1935, on the co-pending application of F. M. Kern, Serial No. 521,092, filed March 9, 1931, and assigned to the assignee of the present invention. The honing tool includes a universally jointed spindle 6 on the lower end of which a pair of slotted spiders 7 and 8 are mounted in fixed spaced relation. Holders 9 engage abrading elements 12 with which guiding members 11 are retained within the slots in the spiders by garter springs 13 and 14 which engage the arcuate fingers 15 provided on the ends of the abrading and guiding elements.

The honing elements are moved radially of the spindle 6 by a conical adjusting sleeve 16 which is slidable thereon and which engages the ends 17 of pyramidal projections 18 provided on the holding elements 9. A spring 19 is provided between the spider 8 and the lower end of the sleeve 16 for biasing it upwardly on the spindle. The conical sleeve 16 is moved downwardly by fingers 21 provided integrally with an annular ring 22 which encompasses the universal connection 23 of the spindle 6.

A spring 24 is positioned above the annular ring 23 over which a sleeve 25 extends, having an upwardly threaded portion 26 which closely engages the upper portion of the spindle 6 which is in slidable relation thereto. The spring may be of any type, although we preferably employ a spring illustrated and described in the above mentioned co-pending application. A threaded nut 27 is positioned on the upper end of the spindle 6 in engagement with the thread thereof and a locking nut 28 is provided which may be jammed relative to the nut 27 for locking the nut in a predetermined position on the spindle. The lower portion of the nut 27 is of reduced outer dimension to receive a bearing 29 against which a cam carrying collar 31 abuts when positioned in extension of the nut.

A plurality of cams 32 are pivoted on the collar 31 for the purpose of adjusting the sleeve 25 longitudinally of the spindle. An adjusting nut 33 is threaded on the portion 26 of the sleeve 25 and a cam engaging collar 34 is mounted thereabove in slidable relation to the portion 26 of the sleeve. A plurality of ball bearings 35 are provided between the nut 33 and the sleeve 34 which engage a plurality of notches 36 provided in the nut 33, for the purpose of indexing the adjustment, as more clearly described in the above mentioned co-pending application.

A cage 37 retains the balls 35 in predetermined relation to each other and a projection 38 on the inner periphery of the cage engages a slot in the portion 26 of the sleeve 25 for positioning the cage against rotation relative to the sleeve. In Fig. 1, the cams 32 are illustrated as being in abrading element collapsed position, which is that illustrated in Fig. 3, wherein the conical element 16 is moved upwardly effected by the spring 19 in the presence of the upward movement of the sleeve 25 relative to the cam collars 31. The degree of expansion is regulated through the adjustment of the adjusting nuts 33 to effect a relative longitudinal change in its position relative to the threaded portion 26 of the sleeve 25, to thereby effect the adjustment of the sleeve relative to the nut 27.

In Fig. 6, we have illustrated a machine 47 having a rotatable shaft 48 which is movable upwardly and downwardly through the medium of a handle 49 to effect a longitudinal and rotational movement to the tool 5. A sleeve 51, of substantially the diameter of the cylinder 52 to be machined, is supported by an arm 53 in aligned spaced relation to the cylinder 52, to receive the guiding and honing elements when the tool is in retrieved position, as illustrated in the figure. 10 When the handle 49 is moved downwardly the tool moves downwardly through the sleeve 51, to cause the guiding members 11 and the abrading element 12 to pass into the cylinder 52, and the cams 32 to be engaged by the inner surface of the sleeve 51.

The movement of the cams 32 forces the washer 34 downwardly relative to the cam carrying collar 31 to thereby force the sleeve 25 downwardly relative to the positioning nut 27 to apply a predetermined deflection to the spring 24 which effects a thrust to the spring cage 41 and bearing 42, through the annular ring 22 and fingers 21 to move the conical member 16 downwardly relative to the spindle. The downward thrust to the member 16 forces the holders 9 outwardly to expand the abrading elements 12 into contact with the cylinder wall. The bias of the spring 24 will be effective until the lower inner edge of the cage 41 engages the top portion of the universal joint 23 of the spindle, at which time the cylinder wall will be honed to a predetermined diameter.

The sleeve for actuating the cams 32 is of such length as to retain the elements expanded during the time at least one half of the length of the honing elements are retained within the cylinder bore so that when the tool is moved beyond such a distance in either direction they will immediately collapse and prevent the deformation of the cylinder wall. In the presence of the possible tiltable positioning assumed by the abrading elements when moved beyond one half of their length in the cylinder they may be tilted and thereby machine the edges of the bore to a greater diameter. In this construction, when the hone is inserted to within the cylinder, the honing elements will be in collapsed position until at least one half of the length of the elements have been inserted within the bore, at 50 which time the cams 32 will be engaged to expand the honing elements against the side of the bore. The cams will be retained by the sleeve during the reciprocatory movement of the tool until such time as it is withdrawn from 55 the bore when the elements will be collapsed through the disengagement of the cams from the inner surface of the sleeve.

Referring to the drawings, it will be noted that between each of the abrading or honing elements 60 12, we have mounted guiding elements 11, which are preferably made of cork but which may also be made of other material such as felt, belting and the like. The cork is supported in a shell 43 which has been described and claimed in the co-pending application of K. W. Connor, Serial No. 574,380, filed Nov. 11, 1931, and assigned to the assignee of the present invention. The holders 9 are employed for receiving the honing elements 12 and are provided with the frusto 70 pyramidal portions 18 as referred to hereinabove, which are engaged by the conical members 16 for expanding the honing elements relative to the spindle. It will be noted that the holding elements 9, employed for receiving the guiding 75

elements 11, have the frusto pyramidal portion 18 omitted and that the conical member 16 at no time engages the holders for the guiding members. The guiding members are retained at all times in fixed relation to the spiders 7 and 8 while the honing elements are adjustable relative thereto.

In order to have the guiding members effective for engaging the cylinder walls at all times the cork, or other material employed therefor, is so constructed as to extend beyond the expansion limits of the honing element 12 to thereby always engage the cylinder wall and to be available when the honing elements are collapsed for guiding the tool so that the honing elements are retained out of contact with the machined surface of the bore. During the honing operation the guiding elements are available for retaining the honing elements in aligned relation in the cylinder and are effective for assisting in obtaining an extremely fine finish on the surface of the cylinder wall in the presence of the wiping action provided thereby.

While we have illustrated in Figs. 2 and 3 a conventional form of mounting for the guide and abrading elements, it was found that a more desirable mounting may be effected by having the abrading elements oppositely disposed to each other and the guiding elements positioned therebetween. Accordingly, we have illustrated in Figs. 4 and 5 a modified form of our abrading head wherein the abrading elements 12 are mounted in holders 9 which are positioned by spiders 20 in such manner as to be oppositely disposed relative to each other and retained for movement outwardly radially of the spindle. The spindle 6 and the conical actuating element 16 are similar to those described hereinabove and effect the lateral adjustment of the elements relative to the cylinder wall. Between each of the abrading elements a recess 30 is provided wherein a plurality of guiding elements 11 are disposed and retained in fixed relation to the spiders 20 without employing the shoes or holding elements 9, as illustrated in Fig. 3.

The channel members 39, for receiving the guiding elements, are provided with outwardly disposed tongues 40 having projections 43 thereon which engage recesses 50 on the inner face of the spiders for retaining the guiding elements in fixed relation thereto. By eliminating the shoe as a support for the guiding elements, substantially the same minimum diameter of the grinding head of the tool is retained as was provided when six of the shoes or holding elements were utilized. In Fig. 4 it will be seen that only four of the holding elements 9 are employed which, though reducing the space between adjacent honing elements, provide sufficient area for receiving the guiding elements therebetween.

The channel members 39 for the guiding elements are flared outwardly at the sides, as at 60, to permit the compression of the cork, or other resilient material which goes to make up the guiding element, and at the same time to provide sufficient rigidity and adhesion between the member 39 and the element to retain it in fixed relation thereto and to prevent it from being torn or weakened during compression. The flared outside portions 60 are cut away at the ends, so that the members 39 will fit within the recesses 30 provided in the spider. The guiding elements and the abrading elements are diametrically disposed to each other and a more accurate honing of the cylinder wall ensues. It is to be understood

that our invention is not limited to four abrading elements but that any even multiple thereof is preferably employed rather than an odd number which may be utilized as illustrated in Fig. 3.

Referring to Figs. 7, 8, and 9, we have illustrated modified forms of guide elements in which a surfacing member 54 is secured to the outer surface of the guide member by an adhesive material or by other methods, for the purpose of protecting the cork or other relative resilient material employed therefor. The member 54 may be made of fiber, metal, or other desirable material depending upon the type of cut to be made in the cylinder bore. When a high finish is desired on the walls of the cylinder, a fiber material may be employed, while if a rough cut is intended a metal surfacing member may be utilized which, in some instances, may be constructed of an extremely hard metal to effect a burnishing or lapping operation on the cylinder wall. In either case, the resiliency of the main body portion of the guiding elements permits the adjustment of the members 54 in accordance with the diameter of the cylinder bore.

The metal surfacing member may be chrome plated or otherwise treated to provide the extremely hard surface which will not wear when subjected to the abrasives present in the cylinder. If desirable, the metal may be set within the cork to have the cork brush the wall free of the material ahead of the metal to eliminate the eroding action entirely therefrom. As a further extension of our invention we may construct the honing elements themselves of a metal having predetermined characteristics and of such construction as to embody therein an abrasive substance and also a lubricant to form honing sticks which are not only abrasive but which will act as guiding elements to retain a substantially uniform surface.

We have in mind such metal as powdered tungsten embodied with an abrasive, such as that known in the trade as "Carborundum", and a lubricant, such as graphite, which may be powdered and uniformly mixed with the powdered tungsten or similar metal and by pressure and heat, in a well known manner formed into a solid element. Preferably the resulting sintered element is then impregnated with a low melting point metal such as copper, silver or the like. Such a metal would provide the guiding characteristics mentioned hereinabove as well as embodying abrasive and lubricating characteristics for effecting the machining operations by producing rapid cutting and a high burnished and polished finish to the cylinder wall.

If such metals are used only as guiding elements the abrasive material may be omitted and the lubricant alone provided to permit the free operation of the elements on the cylinder surface. On the other hand, if the lubricant is not desired, the metal may be constructed with the abrasive material only distributed evenly throughout to produce only the abrasive effect necessary in a cutting element.

By disposing the sleeve 51 in close but spaced relation to the cylinder 52, the member 54 will bridge the space and prevent the resilient material of the member from bulging at the space between the sleeve 51 and cylinder 52 which might cause the material to be cut and torn when moved from and into the sleeve and cylinder. The more rigid material employed in the member 54 prevents the bulging of the resilient material and permits the sliding of the element from the sleeve

and cylinder without any distortion of the resilient portion of the guiding element.

Referring to Fig. 1 it will be noted that the second universal joint is provided on the tool through the connection of the shank 44 which embodies a bayonet type of engagement effected between the shank and the tool through the provision of the arcuately shaped collar 45 and pin 46. It will be noted that the pin 46 is disposed 90 degrees from the pin of the universal joint 23 disposed in the spindle proper, and in this manner complete floating movement is effected to the honing element during the machining operation. Such flexibility is extremely desirable to permit the honing elements to follow the contour of the bore rather than to be operated in angular relation thereto which would occur when the tool is rigidly supported on a driving member and is in slightly off center relation to the center of the cylinder bore. In the present construction only the approximate location of the cylinder is necessary, as the flexibility of the tool takes care of any slight variation in the off center relation between the driving member and the cylinder bore.

Referring to Figs. 10, 11, and 12, we have shown a modified form of shank which may be employed with the honing tool illustrated in Fig. 1, and which embodies a universal movement of the preferred construction. The upper end 56 of the tool is cylindrical in shape so as to engage the cylindrical bore of a portion 57 of a shank 58, to form a rigid assembly which is retained against relative longitudinal movement by the slot and pin connection 59 of a well known type. The portions 57 and 58 are each provided with two upstanding bosses 61, as illustrated more clearly in Fig. 11, between which a hub 62 is positioned. A pin 64 extends through a pair of bosses 61 and the hub 62, while a pair of pins 65 extend through an opposite pair of bosses 61 and the hub to permit an angular movement between the portions 57 and 63 of the shank in all directions. In this construction, a complete universal movement is provided between the two portions 57 and 63 of the shank 58, independent of the bayonet connection between the shank and the tool. The maximum permissible angularity between the two members 57 and 63, while small, is sufficient to permit a considerable misalignment between the tool and bore during a honing operation.

With the construction herein described and illustrated we are able to decrease the time and care required heretofore to machine cylinder walls to precise dimensions and having extremely smooth surfaces. We accomplish such a result by materially increasing the speed of the tool and operate the tool at the high speed without the necessity of shutting down the tool at any time either when inserting or withdrawing the tool from the cylinder bore. We are able to successfully operate the tool at high speed by employing guiding elements which are preferably constructed of cork and which engage the cylinder walls at all times whether the honing elements are in expanded or in collapsed position to thereby guide the honing tool relative to the cylinder wall and at the same time effect rapid cutting due to the high speed operation of the tool.

An exceedingly smooth and polished finish is effected to the cylinder walls in the presence of the guiding elements which act as wiping elements. The wiping elements operate in con-

junction with the cutting elements to effect an exceedingly high polish as the bias on the honing elements is reduced, in the presence of the machining operation on the wall. The guiding elements are mounted in fixed but removable relation to the honing tool and the expansion and contraction of the honing elements is effected in a well known manner relative to the fixed position of the guiding elements.

It is to be understood that the cork or other material employed for the guiding elements is resilient and will thereby compress when inserted within the cylinder walls to provide an outward bias which will be available to retain the guiding elements in contact with the cylinder walls as the walls are ground away and to be available to position the honing tool when the honing elements are moved to retracted position. We find cork to be the most desirable material to be employed in the guiding members in view of its resistance to wear and the large amount of resiliency embodied in the material. However, any other material well known in the art to be suitable may be substituted for the cork to be employed as the guiding member.

While we have described and illustrated but a single embodiment of our invention, it will be apparent to those skilled in the art that many changes, omissions, additions and substitutions may be made therein without departing from the spirit and scope of our invention, as set forth in the accompanying claims.

We claim as our invention:

1. A guiding element for a honing tool made of cork and having a work engaging surface of relatively less resiliency.
2. A guiding element for a honing tool made of cork and having a work engaging surface made of fiber material.
3. A guiding element for a honing tool made of cork and having a work engaging surface made of metal.
4. A guiding element for a honing tool made of resilient material and having a work engaging surface of relatively less resiliency.
5. The combination with an adjustable abrading element of a honing tool, of a plurality of guiding members positioned relative thereto and supported in fixed relation to said tool, said guiding members being made of resilient material, and a member of less resiliency attached to the surface of said material.
6. The combination with an adjustable abrading element of a honing tool, of a plurality of guiding members positioned relative thereto and supported in fixed relation to said tool, said guiding members being made of a resilient material, and a surfacing member for said guiding member made of fiber material.
7. The combination with an adjustable abrading element of a honing tool, of a plurality of guiding members positioned relative thereto and supported in fixed relation to said tool, said guiding members being made of a resilient material, and a surfacing member for said guiding member made of metal.
8. A high speed honing tool which comprises a universally jointed spindle, adjustable supporting elements and cam members for regulating the expansion of said elements, of abrasive elements mounted on said supporting elements for adjustment laterally of said spindle, guiding members disposed circumferentially between said abrading elements and mounted to be non-expandible therewith and to project therebeyond

when the abrading elements are retracted to said spindle, a sleeve positioned in aligned relation with a cylinder to be ground but spaced therefrom a predetermined distance and employed for engaging said cam elements for effecting the expansion and the collapse of said abrading element relative to said cylinder hone.

9. A high speed honing tool which includes, in combination, a universally jointed spindle, abrasive elements mounted on said tool and adjustable laterally of said spindle, cam elements for regulating the said adjustment, guiding members disposed relative to said abrading element and mounted in fixed relation to said spindle, a sleeve positioned in aligned relation to a cylinder to be ground but spaced therefrom a predetermined distance and employed for engaging said cam elements for effecting the expansion and the collapse of said abrading element relative to the cylinder wall, and cylinder wall engaging elements of less resiliency than said guiding members, secured to the outer surfaces of said guide members for engagement with the cylinder wall and the wall of said sleeve.

10. In a cylinder honing tool, a support, abrading elements disposed about said support, means for adjusting said abrading elements radially, and guiding elements having rearwardly projecting spring fingers which releasably engage said support, independent of said adjustable means.

11. In a cylinder honing tool, a flexible joint between the driving and abrading end thereof, abrading elements radially adjustable on the abrading end of a tool, and guiding elements on the abrading end of the tool mounted between said abrading elements in a manner to have the elements and guides positioned to be intersected by a plane normal to the axis of the tool, said guides being non-expansible with said abrading element.

12. A guiding element for a honing tool made of resilient material and having a work engaging surface of relatively less resiliency, and a backing member to which said guide element is secured in unit relation.

13. A guiding element for a honing tool made of resilient material and having a work engaging surface of relatively less resiliency, and a channel member to which said guide element is secured in unit relation.

14. A guiding element for a honing tool made of resilient material and having a work engaging surface of relatively less resiliency, and a channel member to which said guide element is secured in unit relation, said channel member having means for securing the unit element in desired position against movement.

15. A honing tool adapted to be moved longitudinally relative to a work piece into and out of engagement with said work piece during rotation of said tool relative to said work piece, comprising, in combination, a driving end, an abrading end, a flexible connection between said driving and abrading ends, abrading elements carried by said abrading end, adjusting means actuatable during rotation of said abrading end relative to said work piece for collapsing said abrading elements, and guide means for said abrading end effective to maintain said abrading end in substantial axial alignment with said work piece after collapse of said abrading elements.

16. A honing tool adapted to be moved longitudinally relative to a work piece into and out of engagement with said work piece during rotation of said tool relative to said work piece, comprising, in combination, a driving end, an abrading end, a flexible connection between said driving and abrading ends, abrading elements carried by said abrading end, adjusting means operable during rotation of said abrading end relative to said work piece for expanding said abrading elements into engagement with said work piece, and guide means carried by said abrading end effective to maintain said abrading end in substantial axial alignment with said work piece pending said expansion of said abrading elements.

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