

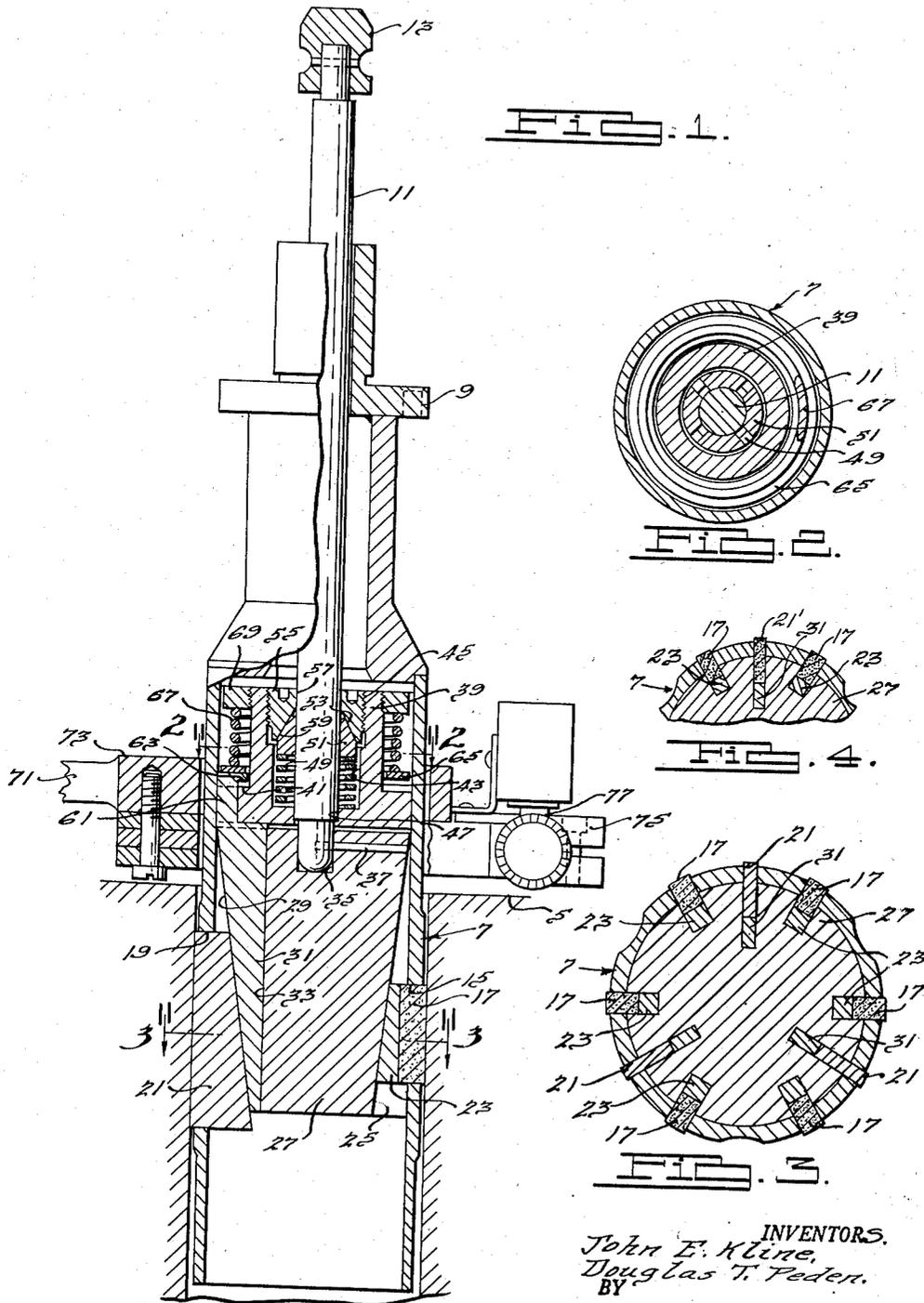
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HONING TOOL

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## HONING TOOL

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This invention relates to honing tools, and particularly to an improved honing tool for use with a device for accurately gaging the inside diameter of a cylinder during the machining operation and interrupting the operation when a desired diameter has been reached.

This invention relates to and constitutes an improvement of the structure illustrated, described and claimed in U. S. Patent 2,308,356, issued January 12, 1943, and that in the application for U. S. Letters Patent, Serial No. 499,472, filed August 21, 1943, now abandoned, both of which were assigned to the assignee of this invention.

In the aforementioned U. S. Patent 2,308,356, a caliper or measuring device is disclosed which directly measures the size of the tool during its operation in a bore, to thereby measure the bore which could be finished to any desired dimension. The abrading members of the honing tool were arranged to directly contact the measuring device at an extremity of the working stroke to actuate the device when the diameter had been reached. It was found that a slight abrading effect occurred as a result of the contact of the gaging element with the abrading material, which necessitated occasional readjustment of the gaging mechanism to compensate therefor.

In the above mentioned patent application, Serial No. 499,472, the necessity for readjusting the gage mechanism was substantially reduced by virtue of providing nonabrading tabs at the extremes of the abrasive stone, which in turn contacted the gaging element so as to interrupt the operation of the machine when the desired diameter has been obtained. It has been found when using the embodiments of the aforementioned patent application for honing cylindrical bores of extremely hard material, in particular, that occasionally the nonabrading tabs at the extremities of the abrasive do not react to the pressure applied in the same degree as the abrading elements which are honing the cylindrical bore. This results, on occasion, in the diameter of the nonabrading tabs varying slightly from the diameter of the honed cylindrical bore and therefore reflects on the accuracy of the aforementioned measuring arrangement.

It is therefore an object of this invention to provide improved and simplified honing tool and measuring means associated therewith for accurately measuring the diameter of a cylindrical bore during the honing operation.

It is a further object of this invention to provide bore engaging elements independently asso-

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ciated with the abrasive wearing elements which will accurately gage the diameter of the cylindrical bore regardless of relative compression characteristics of the bore engaging elements.

It is a still further object of this invention to provide a honing tool which can be retracted from a cylindrical bore without the abrasive elements scratching or injuring the surface thereof.

It is a still further object of this invention to provide a honing tool which is simple in construction, inexpensive to manufacture and especially accurate in operation.

These and other objects of this invention will become apparent from the following detailed description taken in conjunction with the accompanying drawing, in which:

Figure 1 is a view, partly in section and partly in elevation, of a honing tool embodying features of this invention;

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

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

Fig. 4 is a broken view of structure illustrated in Fig. 3, showing a further form of the invention.

Referring now to the drawing, the cylindrical bore which is to be honed is designated at 5, and the honing tool includes a conventional housing element, generally indicated at 7, adapted to enter the bore. Adjacent the upper end of the housing 7, a driving element 9 is provided. An axially actuatable rod 11 passes longitudinally through the center of the housing 7 and on its upper end has a coupling 13 secured thereto. The honing tool of this invention is adapted to be mounted in a honing machine of the type illustrated in Patent No. 2,350,527, issued June 6, 1944, and assigned to the assignee of the present invention. As can be seen in that patent, the driving element 9 is held in the honing machine, and the coupling 13 is adjustably connected therein. Due to the construction of the machine of that patent, the entire housing 7 will be reciprocated and rotated thereby and the adjustable rod 11, due to the connection of the coupling 13 within the machine, may be axially adjusted with respect to the housing during the rotation and reciprocation of the tool itself.

Adjacent the lower end of the housing 7, a plurality of radially spaced openings 15 are provided through the wall thereof which are adapted to receive a plurality of abrasive honing stones, indicated at 17. Additional openings 19 are dis-

posed between some of the openings 15 in the housing 7 for receiving a set of bore engaging or guide elements 21. The honing stones 17 have nonabrasive holders 23 secured thereto provided with a sloping inward face. The holder and stone project into one of a plurality of inclined slots 25 radially spaced on the outer periphery of a cylindrical plug 27 slidably fitted into the lower end of the housing 7. The slots 25 are of the same inclination as the holders and define the periphery of a cone, the base of which is the diameter of the cylindrical plug 27. The honing stones 17 and holders 23 are disposed within the slots 25 and are caused to move radially outward when the adjustable rod 11 is moved downwardly. This radial movement is produced by the mated inclined surfaces of the slots 25 and the holders 23, and substantial pressure can be exerted there-through to force the honing stones against the cylinder bore.

As can be seen in the drawing, the guide elements 21 are of a greater length than the honing stones 17, for a reason which will be hereinafter brought out. The inner faces of the guide elements 21 are inclined and slidably abut an inclined face 29 formed on cam elements 31. The guide elements 21 may be made of any suitable material such as fibre, metal and the like. It will be noted that the inner faces of the cam elements 31 are flat and disposed against a straight longitudinal face of grooves 33 disposed in the cylindrical plug 27. The cam elements slide within the grooves 33 and have upper faces which may be disposed flush with the upper end of the plug 27. With this arrangement, the plug 27 and guide elements may be moved with or independently of each other.

The lower end of the adjustable rod 11 is received in a recess 35 formed in the upper end of the cylindrical plug 27, and secured thereto by a laterally extending pin 37 or other suitable means.

A floating clutch or cage element 39 is mounted on the shaft 11 within the housing 7 above the plug 27. The element 39 is formed with an annular flange 41 adjacent to its lower end and provided with a central recess 43. The upper end of the recess is threaded as at 45 and the lower end is provided with an opening 47 through the lower wall of the element 39 which permits the adjusting rod 11 to pass therethrough. Surrounding the rod 11 and seated in the recess 43, is a compression spring 49. Coaxial with the adjustable rod 11 and seated upon the upper end of the helical spring 49 are two or more friction shoes 51 whose outer peripheries, of conic section, are inclined downwardly and outwardly as at 53. A cap 55 is threaded into the upper end of the recess 43 and is provided with an opening 57 in the center thereof through which the adjusting rod 11 passes. The inner periphery of the cap 55 is conically complementally inclined, as at 59, to engage the outer inclined periphery 53 of the shoes 51 so that when the cap 55 is threaded down into the recess 43, against the bias of spring 49, it will press the shoes 51 inwardly against the periphery of the adjustable rod 11 to form a slip clutch between the rod 11 and the floating cage 39. It will be noted that the lower end of the floating element 39 may abut against both the cylindrical plug 27 and the upper end of the cam elements 31 in the extreme collapsed position of the tool.

Each of the cam elements 31 has an upwardly projecting arm 61 having on the upper end an inwardly extending hook 63 adapted to extend

over and may be spaced from the flange 41 when the end of the cam element is engaged by the element 39. A washer 65 is disposed on the top surface of the arms 61 against which the lower end of a helical spring 67 abuts. The spring 67 surrounds the element 39 and is compressed to a desired amount by a collar 69 which is threaded on the outer periphery of the element 39 and abuts against the upper end of the spring 67. In honing operations in which extremely fine surface finishes are to be produced on the workpiece, it is recommended that the guide elements maintain the tool body 7 on its axis of rotation as the honing stones are retracted from engagement with the work. Inadvertent re-contacting of the stone with the work is thus prevented, which otherwise might impair the surface finish of the latter. It is to be understood, however, that this function of the guide elements is not necessarily required for gaging purposes and that, therefore, the space between the inwardly extending hook 63 and flange 41 may be omitted, and the cam elements 31 thus be caused to move longitudinally directly in accord with the axial movement of cage 39. In such instances, the washer 65, spring 67 and collar 69 may be omitted from the structure without detracting from any function of the guiding elements except their stabilizing of the hone body immediately prior to the engagement of the stones and the work surface and immediately subsequent to the retraction of said stones from said work surface.

As seen in Fig. 1, positioned above the cylindrical bore 5, and mounted on the honing machine, is a gaging device comprising a bracket 71 which supports a sleeve 73 in alignment with the honing tool which is reciprocated there-through. Either a caliperlike or ringlike gaging element 75 which, when engaged by the guide elements 21, as will be hereinafter described, will cause the gaging element 75 to trip a switch 77 to interrupt the operation of the machine. A caliperlike gaging device is described in detail in the aforementioned Patent No. 2,308,350.

In operation, the honing tool is inserted into the cylindrical bore to be honed, with the diameter of the honing stones and the guide members 21 collapsed to a smaller diameter than the bore 5. The diameter of the guides being slightly larger than that of the stones, will engage the bore first so as to stabilize the tool until the honing stones contact the bore. During this phase, the honing machine is put into operation causing simultaneous reciprocation and rotation of the housing 7. As the housing 7 rotates, it likewise causes the honing stones 17 and guide elements 21, mounted therein, to rotate therewith. Due to the construction of the honing machine, as aforementioned, the adjusting rod 11 is moved downwardly to cause the honing stones to engage the cylindrical bore 5 with increasing pressure. As the rod 11 is pushed downwardly, the honing stones 17 will be forced outwardly against the wall of the cylindrical bore 5 by the action of the inclined slots 25 in the cylindrical plug 27 on the rear sloping surface of the holders 23. At the same time, the guide elements 21 will be forced outwardly against the wall of the cylindrical bore due to the action of the element 39 carried by the rod 11 on the cam element 31. The element 39 will continue to move with the adjusting rod 11 until the pressure between the cylindrical bore wall and the guide elements 21 reaches a predetermined amount. At that time, the shoes 51 will slip on the rod 11 as the rod continues to move

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downwardly to apply further movement and pressure on the honing stones 17. During this last movement, the plug 27 will move relative to the flat face on the cam element 31 disposed in the straight slots 33 of the plug. As the honing stones 17 enlarge the diameter of the bore 5 during the honing operation, the pressure between the guide elements 21 and the bore is maintained by the frictional "drag" between the shoes 51 and the rod 11, which causes the clutch element 39 to force the cam elements 31 downwardly, when the plug 27 is moved downwardly, and radially actuate the guide elements against the bore wall until the pressure therebetween again causes the shoes 51 to slip on the rod 11. This engaging and disengaging of the slip clutch occurs periodically during the honing operation, as determined by the pressure between the guide elements and the bore wall. In this way, the guide elements 21 are kept in engagement with the bore wall so that they axially stabilize the tool and can be used to gage the diameter of the bore, as will be brought out.

As the tool is reciprocated and rotated, the bore wall will be enlarged by the honing stones and the guide elements 21 will enter the gaging device each upward stroke of the tool. The guide elements 21 extend substantially above the upper end of the honing stones 17 so that they alone may enter the gaging device and operate the switch thereof when expanded to the finished diameter as set on the gaging device.

In extremely fine finish honing operations, the honing stones 17, at the end of the operation, exert a substantial pressure against the cylinder bore 5. If the tool were withdrawn while the stones were under such a pressure, they may mar the fine finish of the bore wall. In such instances, the complete structure as shown in Fig. 1 is used, incorporating the washer 65, spring 67 and collar 69 and providing the space between hook 63 and flange 41 which limits the effective movement of the spring 67 and the corresponding relative axial movement between the plug 27 and the cam members 31 at the surfaces 33. Thus, the guide members 21 are caused to maintain contact with the work surface 5 until the abrading members 17 have had their operating pressure upon the workpiece fully relieved by virtue of the upward movement of the plug 27. During the first part of this retractive movement of the plug 27, the pressure on the guide elements will not be materially reduced because, as can be seen in Fig. 1, the spring 67 is acting on the hooks 63 of the cam elements 31 and the latter elements will not be moved upward until the flange 41 engages the bottom surface of the hooks. Thereafter, the elements 21 and stones 17 will be retracted at a uniform rate with the stones collapsed ahead of and further than the guide elements so that the guide elements can prevent the stones from re-contacting and marring the finished bore during withdrawal. The tool is then withdrawn completely from the bore, and the finished bore can be replaced by a new bore which is then honed in the manner described. Upon applying the tool to the new bore, the spring 67 will retain the cam elements 31 advanced relative to the flange 41 so that the elements 21 will first contact the bore wall ahead of the stones and be set against the wall with the desired stabilizing pressure before the stones are finally adjusted against the bore wall with the continued movement of the rod 11. As the honing operation progresses and the bore becomes enlarged, radial expansion of the guides 21 is kept apace of the said enlargement by the

movement of the cams 31 and plug 27 as a unit, and the contacting pressure of the guides upon the work could never be less than that resulting from the pressure of the spring 67 times the mechanical advantage of the cam angle 29 of the members 31.

It is apparent to one skilled in mechanical art that the features of this invention may also be used in a combination of bore contacting elements wherein members 17 consist of coarse abrasive and members 21' of fine abrasive. During the operating phase of full pressure contact of all of said members upon the workpiece, a composite surface finish is produced upon the work but, upon a slight withdrawal of the actuating rod 11, the pressure of the coarse abrasives 17 upon the work is released while the spring 67 is permitted to maintain prolonged pressure upon the fine abrasives 21 and thus produce an improvement in quality of the surface finish beyond said composite finish.

What is claimed is:

1. A tool for honing a cylinder bore, including, a body, a first set of bore engaging elements supported in said body for outward movement, a second set of bore engaging elements supported in said body for outward movement independent of said first set, plug means slidably mounted within said body and having a plurality of longitudinally extending slots some of which have the bottom walls disposed parallel to the axis of the plug means, others of which have the bottom walls inclined thereto, said slots extending inwardly from the peripheral surface of the plug means, said first set of elements being disposed in said slots having the inclined bottom walls, said slots having the parallel bottom walls supporting said second set of elements, cam elements engaging said second set of elements when disposed in said slots having parallel bottom walls, single rod-means secured to said plug, and slip clutch means on said rod for engaging said cam elements for permitting additional pressure to be applied to said first set of elements without applying additional force on said second set of elements.

2. In a honing tool having a cylindrical body, a set of radially adjustable abrading elements on said body, a set of radially adjustable non-abrasive elements on said body, said elements of said sets having the inner edges sloping relative to the axis of the body, plug means with the body having surfaces sloping relative to the axis of the body and engaging the sloping surfaces of said set of abrading elements, cam plates in said body movable relative thereto parallel to the axis of the body and having surfaces sloping relative thereto in engagement with the sloping surfaces of the non-abrading elements, an actuating element engaging said plug means for moving the plug means along the axis of the body, and clutch means on said actuating element engageable with said cam plates, said clutch means having slip engagement with said actuating element, said plug means and cam plates moving as a unit to adjust both sets of elements radially when said clutch means is moved with said actuating element and said plug means moving independently of said cam plates when said clutch means slips when said actuating element is moved for radially adjusting the set of abrasive elements without adjusting the set of non-abrasive elements.

3. In a honing tool having a cylindrical body, a set of radially adjustable abrading elements on said body, a set of radially adjustable non-abra-

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sive elements on said body, said elements of said sets having the inner edges sloping relative to the axis of the body, plug means with the body having surfaces sloping relative to the axis of the body and engaging the sloping surfaces of said set of abrading elements, cam plates in said body movable relative thereto parallel to the axis of the body and having surfaces sloping relative thereto in engagement with the sloping surfaces of the non-abrading element, an actuating element engaging said plug means for moving the plug means along the axis of the body, clutch means on said actuating element engageable with said cam plates, said clutch means having slip engagement with said actuating element, said plug means and cam plates moving as a unit to adjust both sets of elements radially when said clutch means is moved with said actuating element and said plug means moving independently of said cam plates when said clutch means slips when said actuating element is moved for radially adjusting the set of abrasive elements without adjusting the set of non-abrasive elements, and spring means between said clutch means and said cam plates for maintaining said cam plates shifted on said plug means when the sets of abrasive elements are unconfined to have the set of non-abrasive elements adjusted to a larger diameter than the diameter of the unconfined set of abrasive elements.

4. In a honing tool having a body, a set of abrasive elements supported on said body, a set of non-abrasive elements supported on said body, cam means engaging said set of abrasive elements and shiftable lengthwise of the body for radially adjusting said abrasive elements, cam plates engaging said set of non-abrasive elements and shiftable lengthwise of the body with said cam means and independently thereof for radially adjusting said non-abrasive elements, a rod secured to said cam means and extending from said body, and a clutch element circumferentially engaging said rod and having slip engagement therewith, said clutch element being engageable with said cam plates, when the cam

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plates offer a minimum of resistance to movement and which is retained stationary as the rod and plug means is moved when the resistance against movement of the cam plates has increased to a predetermined amount.

5. In a honing tool having a body, a set of abrasive elements supported on said body, a set of non-abrasive elements supported on said body, cam means engaging said set of abrasive elements and shiftable lengthwise of the body for radially adjusting said abrasive elements, cam plates shiftable lengthwise of the body with said cam means and independently thereof for radially adjusting said non-abrasive elements, a rod secured to said cam means and extending from said body, a clutch element circumferentially engaging said rod and having slip engagement therewith, said clutch element being engageable with said cam plates, spring means between said clutch element and said cam plates for applying a predetermined force to the cam plates, for shifting said cam plates, and engaging means on said cam plates and said clutch element for limiting the expansion of said spring means and the amount of movement of said cam plates produced thereby.

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