

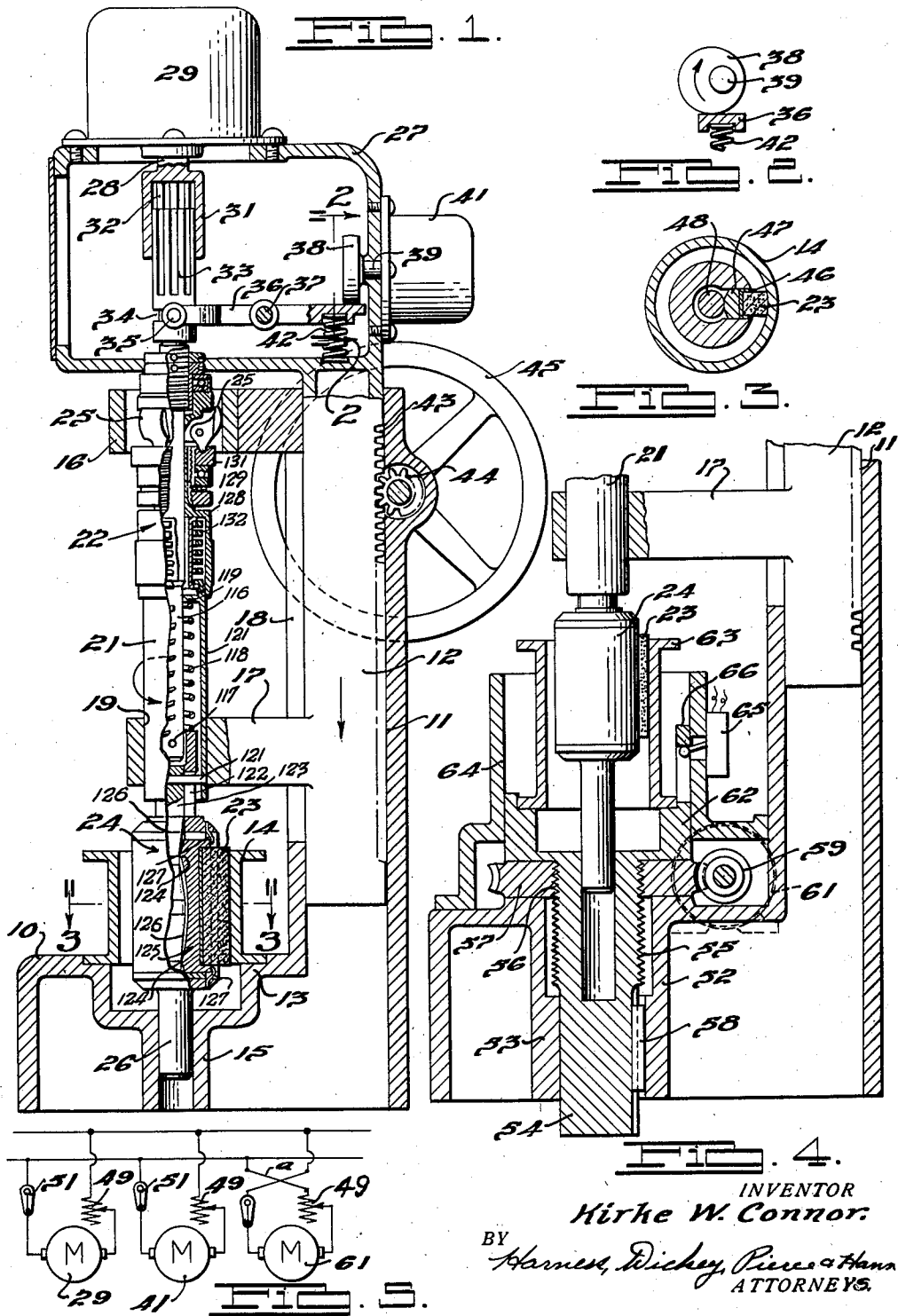
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HONING DEVICE

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HONING DEVICE

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1 Claim. (Cl. 51—34)

My invention relates to honing methods and apparatus, and particularly to a honing method and device which employs a single abrading element which is rapidly oscillated and advanced relative to a surface to be honed to produce an accurate and highly polished surface.

In my co-pending application, Serial No. 76,519, filed April 27, 1936, and assigned to the assignee of the present invention, a method and apparatus are disclosed wherein a plurality of honing elements are rapidly reciprocated in timed relation to the speed of rotation of the tool to produce a predetermined angular intersection of the paths of abrasion during the time the tool and work are fed relative to each other. Certain features embodied in the invention of the above mentioned application appear in the present invention.

In the present invention a single honing element is employed which eliminates any binding and uneven wear on the stones which may occur when a plurality of the stones are employed in a single tool. It is substantially impossible to grade the abrading stones relative to hardness so that when a group of stones are employed, the wearing qualities of some are materially greater than those of others and, as a result, certain stones wear faster than others, causing a binding between the stones when depending upon each other for support within the work piece and uneven wearing of the stones.

One embodiment of the present invention utilizes a single stone which is urged against a cylindrical surface to be machined by a force which reacts against the stone support. The same principle is extended in other embodiments herein illustrated, wherein a single stone is employed for machining tapered surfaces, either internal or external, and for machining cylindrical external surfaces.

Due to the rapid oscillation of the honing stone, a method of grinding is provided which simulates that of hand polishing wherein the hand is rapidly oscillated to move an abrading element over the surface to be honed. A feed movement is introduced between the oscillating stone and the work to extend the abrading operation uniformly over the surface.

Accordingly, the main objects of my invention are: to provide a method whereby an abrading stone is rapidly oscillated during the time a feed movement is provided between the work and the stone; to provide apparatus for honing internal cylindrical surfaces employing a single stone in which the spindle supporting the stone is rigidly

retained centrally of the surface to provide support for feeding the stone toward the surface; to provide operating mechanism for rapidly oscillating the spindle axially during the time it is rotating, and advancing the stone carried by the spindle over the length of surface to be machined during said reciprocation and rotation; to provide rapid reciprocation of a single honing element having an engaging surface congruent to that of the work and advancing the work and honing stone relative to each other to cover the entire surface to be finished; and, in general, to provide apparatus for accurately machining surfaces to a high mirror finish, which is simple in construction, positive in operation and economical of manufacture.

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

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

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

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

Fig. 4 is a view of structure, partly in section and partly in elevation, which may be utilized with the structure illustrated in Fig. 1; and

Fig. 5 is a wiring diagram which may be employed for controlling the structures illustrated in Figs. 1 to 4.

In Fig. 1, I have illustrated a device for honing a work piece which embodies a supporting housing 10 having a column 11 within which a vertically adjustable pillar 12 is supported. The housing 10 has a support 13 for a work element 14 for locating the work element relative thereto and to a pilot guiding cylinder 15 which forms part of the housing. On the upper portion of the column 11 a tool controlling sleeve 16 is provided aligned with the pilot cylinder 15.

The pillar 12 carries a boss 17 which projects through a slot 18 in the column 11 having a cylindrical opening 19 therein in which the shank 21 of the honing tool 22 is journaled to be accurately aligned with the pilot cylinder 15. The tool 22 is similar to a conventional honing tool such as that illustrated and described in the patent to F. M. Kern, No. 1,990,331, issued February 5, 1935, and assigned to the assignee of the present invention. In the present tool, however,

a single abrading stone 23 is employed which is projected radially from the stone supporting head 24. Suitable mechanism, described in detail hereinafter, is employed in the head 24 for adjusting the stone radially and for cooperating with the cam fingers 25 for retracting and expanding the stone 23. The end of the abrading head 24 is provided with a pilot 26 which operates in the pilot cylinder 15 of the housing 10. The tool is accurately guided within the cylindrical opening 19 of the boss 17 and within the pilot cylinder 15 through the engagement of the shank 21 and the pilot 26 of the tool therewith, respectively.

The operating mechanism for driving the tool in rotation and in reciprocation is carried by a housing 27 supported on and carried by pillar 12. Within the housing 27 a shaft 28 of a motor 29 projects, having the end 31 thereof of cup shape and machined to provide a plurality of splines 32. The end of the tool 22 has a plurality of cooperating splineways 33 machined therein which are engaged by the splines 32 of the cup shaped portion 31 of the shaft 28 to provide a rotative driving connection between the motor 29 and the tool 22 which permits the reciprocation of the tool during its rotation. A slot 34 is provided in the end of the shank of the tool 22 in which fingers 35 of a bifurcated link 36 project to effect the reciprocation of the tool during the time it may rotate. The link 36 is pivoted at 37 and its end, opposite to that containing the fingers 35, is disposed to be engaged by a cam 38 secured to a shaft 39 of a motor 41. A spring 42 urges the end of the link 36 toward and against the surface of the cam 38. This relationship is illustrated more clearly in Fig. 2.

The pillar 12 is provided with a plurality of rack teeth 43 which are engaged by a pinion 44 mounted in the wall of the column 11, which pinion is operated by a hand wheel 45. Through the operation of the hand wheel 45 the pinion 44 is rotated, causing the pillar 12 to be raised and lowered relative to the housing 10. The raising operation will move the tool upwardly out of the work and permit a new work piece 14 to be inserted within the work holder portion 13 of the housing.

In Fig. 3, I have illustrated in section the work element 14 being engaged by the honing stone 23. The honing stone may be of conventional type, being supported in a backing element 46 which is secured relative to a shoe 47 in the conventional manner. The shoe 47 is engaged by a cone element 48 which urges the shoe 47 and stone 23 outwardly against the surface of the work element 14 when moved in one direction, and which will release the shoe 47 and stone 23 when moved in the opposite direction. In this manner, the stone may be moved to retracted position before being withdrawn from and inserted within the work piece and may be urged against the surface of the work piece after being inserted there-within, and fed outwardly during the abrading operation.

After a work piece 14 is inserted within the support 13 of the housing 10, the motors 29 and 41 are energized to effect the rotation of the tool and its oscillation in predetermined timed relation. In Fig. 5, I have illustrated a wiring diagram wherein motor 29 and motor 41 are adjustable in speed through the rheostats 49. Through this adjustment the cycle of reciprocation relative to the speed of rotation may be accurately controlled so that the desired finish may

be obtained through the control of the angle of intersection of the paths of abrasion due to each half cycle of reciprocation. This has been pointed out in detail in my above mentioned co-pending application. After the abrading operation has been completed, the operation of the hand wheel 45 moves the cam fingers 25 out of the sleeve 16 and thereby causes the stone 23 to be retracted so that it may be withdrawn from within the surface of the work piece without marring the surface and without shutting off the motors. When a new work piece has been disposed in the support 13, the operation of the hand wheel in the opposite direction lowers the tool and stone 23 to a position within the work piece 14 and thereafter the cam fingers 25 engage the sleeve 16 and are operated to cause the extension of the stone 23 into engagement with the surface of the work element 14. The machine is shut down through the operation of the switches 51 for shutting off the motors 29 and 41.

In Fig. 4, I have illustrated a further form which my invention may assume, that wherein the work piece to be machined is of greater length than the stroke of oscillation of the tool. While the hand wheel 45 of Fig. 1 could produce such additional feed movement when the sleeve 16 is lengthened, in this instance a work support is provided which is movable relative to the tool head 24 so that the work is fed relative to the stone 23. The projecting portion 52 of the housing is provided with a boss 53 in which the shaft 54 of the work support 62 is journaled for longitudinal movement. The shaft is provided with a thread 55 engaged by the inner threaded surface 56 of a worm wheel 57. The shaft 54 is keyed at 58 to prevent rotation of the shaft when the worm wheel 57 is rotated. Such rotation is effected by a worm 59 driven by a motor 61. The head 62 is guided within a cylinder 64 suitably supported on and secured to the frame portion 52. A reversing switch 65 is operated by a projecting finger 66 carried by the head to cause the motor to reciprocate and return the work to its original position after it has moved a predetermined length relative to the stone 23. The motor 61 is illustrated in Fig. 5 as also being provided with a rheostat 49 for controlling its speed of operation, to control the speed of the feed movement between the stone 23 and the work 63, relative to the rates of reciprocation and rotation thereof.

The structure and operation of the device is generally similar to that described relative to the construction illustrated in Fig. 1. In the present instance, however, besides the rapid reciprocation of the honing stone 23 and the rotation of the stone, an additional controlled feed movement is provided.

The tool spindle 116 carries the abrading head 24 on the end thereof, being secured together by a pin 117. A spring 118 encompasses the spindle 116, having one end resting upon the end of the projection of the head 24 and the other end disposed against a flange 119 of a sleeve 120 which is biased upwardly thereby. The lower end of the sleeve has a pin 121 extending therethrough and through a slot 122 in the projection of the head 24. The pin supports the stone adjusting element 123 and through the axial movement of the sleeve 121 the radial movement of the stone 23 is controlled. Upon the downward movement of the sleeve the projecting portions 124 of the stone supporting element 125 are engaged by conical surfaces 126 which force the carrier 125 and

abrading stone 23 radially outward against the bias of the springs 127. When the sleeve 121 is moved upwardly the conical surfaces 126 are moved out of engagement with the projections 5 124 on the stone carrier 125 permitting the radially inward movement of the carrier and stone when urged by the bias of the springs 127. An additional sleeve 128 is disposed on the spindle 116 above the sleeve 121 which sleeve carries a nut 10 129 threaded thereto. Through adjustment of the nut 129 the cam collar 131 is positioned relative to the sleeve to control the amount of radial expansion of the abrading stone 23. A caged spring 132 is disposed between the sleeve 121 and 128 for the 15 purpose of loading the stone a predetermined amount when the cam fingers 25 are actuated within the collar 16. The setting may be such that the cage of the spring limits the spring expansion and therefore the radial movement of the stone 23. 20

While I have described and illustrated several embodiments of my invention, it will be apparent

to those skilled in the art that various changes, omissions, additions and substitutions may be made therein without departing from the spirit and scope of my invention as set forth in the accompanying claim. 5

I claim as my invention:

The combination in a honing tool of an abrading head supporting a single abrading element, pilot means for retaining the axis of the tool centrally disposed relative to a work piece, means for feeding said abrading element radially of said 10 head, means for advancing and retracting said abrading element relative to said head independently of said expanding means, means for relatively oscillating the tool and work, means for 15 relatively rotating the tool and work in synchronism with said oscillation, and means for introducing a relative feed movement between the abrading element and work parallel to the path of oscillation during said machine operation. 20

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