April 26, 1938. E. HARTMANN 2,115,461

POLISHING MACHINE

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Fig. 1

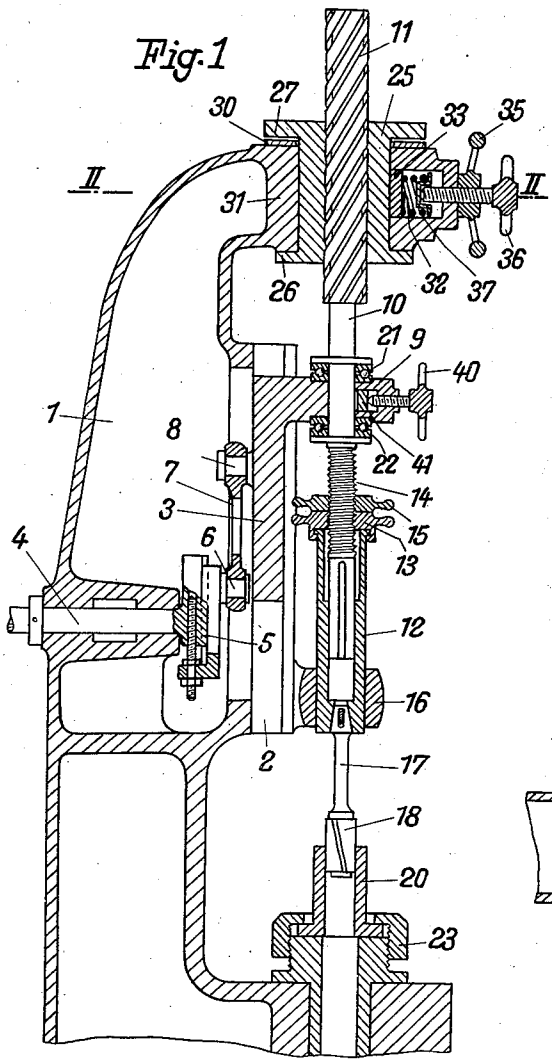


Fig. 3

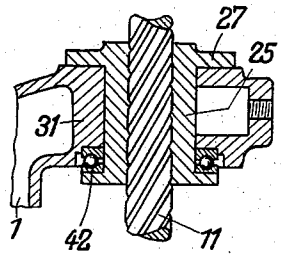
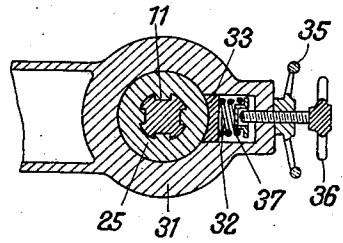


Fig. 2



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POLISHING MACHINE

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In Germany December 7, 1935

8 Claims. (Cl. 51—34)

My invention relates to the treatment of metal and other bodies for the purpose of producing on such bodies absolutely true surfaces. It has particular reference to means for producing smooth and accurately true cylindrical surfaces on workpieces and quite particularly inner surfaces of hollow cylinders. It is an object of my invention to provide a machine capable of doing this kind of work in a better and more efficient manner than similar devices hitherto in use.

Hitherto smooth and accurately true cylindrical surfaces and more especially inner surfaces of hollow cylinders have been produced with the aid of polishing or honing methods, wherein a polishing tool made of metal, stone or the like, to which grinding or polishing agents and lubricating or rinsing liquids were supplied, was carried in alternating directions in contact with the surface to be polished. To this end the tool was fixed on the spindle which was permanently rotated and simultaneously reciprocated by means of suitable gearing. In devices of this kind the number of rotations and the stroke of the tool were adapted to the workpiece to be machined and remained unaltered throughout the machining operation. In a device of this kind it is scarcely possible to adapt the tool motion to the particular character of the surface and to for instance treat particularly vigorously local eccentricities or rough parts of the surface under treatment.

The accurate-polishing machine according to the present invention is designed with a view to allowing a ready adjustment of the intensity of treatment and an automatic adapting of this treatment to the condition of the surface of the individual workpiece. In the new machine the spindle carrying the polishing tool is rotatably arranged on a reciprocable part, such as a slide or the like, and means are provided for imparting to the spindle a non-positive rotation which varies from one sense in one direction to the opposite sense when travelling in the opposite direction. I further provide resistances influencing the angle of the rotary reciprocation brought about by this drive, the resistances effective during the tool movement in one direction differing from those arising during the movement of the tool in the opposite direction, whereby the angular movements imparted to the spindle in one and the other direction are different also. I may further provide means whereby the different resistances influencing the angular movements of the spindle may be increased and reduced, respectively, in the same proportion.

The means for producing such rotary oscillations of the spindle dependent from certain resistances may for instance consist of a sleeve mounted in the machine bed for revolution and being formed with an inner screw thread, into which projects a steep thread formed on the spindle, means such as checks or the like securing the sleeve against axial displacement being provided, which oppose to the rotary movement of the sleeve resistances of different magnitude in one and the other direction of the spindle. Such means capable of equally varying the resistances influencing the rotation of the spindle may for instance adopt the form of brakes which may be made to act on the sleeve or on the spindle itself.

In the drawing affixed to this specification and forming part thereof a polishing machine embodying my invention is illustrated diagrammatically by way of example.

In the drawing

Fig. 1 is a vertical axial section of the machine, while

Fig. 2 is a cross-section on the line II—II in Fig. 1.

Fig. 3 is an axial section of a modified form of the internally threaded sleeve and the parts cooperating with it.

Referring to the drawing and first to Figs. 1 and 2, 1 is the standard carrying the operative parts of the machine and 2 is a guide, on which a slide 3 is mounted for vertical reciprocation. 4 is a shaft driving an adjustable crank 5 with the crank pin 6, connecting rod 7 and pin 8 mounted on the slide 3, whereby the slide is reciprocated. On the projecting arm 9 of the slide 3 is supported for ready rotation a spindle in two parts 10 and 12, which is secured against axial movement relative to the arm 9. The axial forces acting on the spindle are taken up by ball bearings 21, 22. The top end of the spindle 10 is formed with a steep multiple screw thread 11, the bottom part 12 of the spindle is connected with the top part 10, being longitudinally adjustable, but secured against angular movement relative to it. To this end the part 12 is surrounded by a nut 13 arranged to be screwed on a screw thread 14 formed on the part 10, being securable in its position by a counter-nut 15. The bottom end of spindle 12 is guided in a bearing 16 fixed to the standard 1 and supports the tool carrier 17 carrying the polishing tool 18.

The work piece 20, for instance a hollow cylinder, the inner surface of which is to be polished, is fixed on the bottom part of the standard by means of a screw cap 23 or by other suitable

means. The portion of the spindle 10 carrying the steep thread 11 meshes with the internal screw thread of a sleeve 25 which is rotatably mounted in a hub 31 formed in the top end of the standard 1. The sleeve is secured relative to the standard in axial direction by bearings formed of flanges 26, 27 of the sleeve which cooperate with the end faces of the hub body 31. The smooth metal surface of the bottom flange 26 is in direct contact with the bottom surface of the hub body 31, while between the top flange 27 and the top surface of the hub body a washer 30 is inserted which is made of a material, such as a compressed asbestos composition possessing a higher friction coefficient than a smooth metal surface. In a cavity 32 formed in the hub body 31 supporting the sleeve 25 is seated a brake block 33 which is forced against the sleeve by a powerful spring 37 acted upon by a screw bolt 36, which can be fixed in position by a counter-nut 35. In a cavity of the arm 9 supporting the spindle 10 is seated a brake block 41 which can be pressed against the spindle 10 by means of a screw bolt 40.

The operation of this device is as follows: When the driving shaft 4 rotates, the slide 3 is reciprocated in the vertical direction together with the spindle 10, 12 and tool 18 by means of the crank gear 5, 6, 7, the spindle brake 41 being assumed to be cut out of action. If the threaded sleeve 25 is assumed to be prevented from turning, the spindle 10 will execute a reciprocatory rising and dropping movement in the screw thread of the sleeve, its angular movements being the same and ending at the same levels throughout the operation of the device. On the other hand, assuming the sleeve 25 to be free to rotate relative to the standard 1 without suffering any resistance, then spindle 10, 12 and the tool 18 will only ascend and descend, however owing to the friction arising between the tool 18 and workpiece 20 the parts will not turn, but the sleeve 25 will execute the angular reciprocatory movement resulting from the stroke of the spindle 10 and the pitch of the screw thread. The actual movement of the spindle 10, 12 during the operation of the machine occurs between these two limits. During the ascending stroke the smooth metallic surface of the flange 26 of sleeve 25 abuts against the smooth surface of the hub body 31. There is little friction between these two parts and the sleeve is therefore free to rotate through a comparatively large angle, while the spindle 10, 12 will rotate only through a small angle. During the descending stroke the metal surface of the flange 27 of sleeve 25 applies itself onto the surface of the friction disk or washer 30, whereby the resistance offered to an angular movement of the sleeve 25 is increased. In consequence of this resistance the sleeve will turn through a smaller, the spindle through a larger angle. During the successive ascending and descending strokes of the spindle this latter will thus be rotated alternately through smaller angles in one sense and through larger angles in the opposite sense, the starting positions of the individual angular reciprocations varying permanently. Owing to this composite movement imparted to the tool an absolutely accurate and true cylindrical surface is formed in the work piece 20.

The resistance opposed by the sleeve 25 may be varied by adjusting the brake block 33 and the angular deflections of the spindle 10 and 12 will be varied correspondingly, becoming the larger, the more vigorously the brake is made to act on the sleeve 25. The angular deflection is further regulated automatically to a certain extent by the frictional resistance offered to the tool by the workpiece, greater friction occasioned for instance by local projections, eccentric portions or the like of the workpiece surface tending to reduce the angular deflection. Consequently the revolution of the tool as a whole proceeds more slowly when the tool acts on such rough or eccentric parts and these parts are therefore acted upon more vigorously than smooth parts, so that the machine automatically adapts the degree of machining to the condition of surface in different places of the workpiece.

It is also possible to influence at will the friction between the tool and the workpiece, for instance by varying the force, which is exerted as a rule by springs, which presses the parts together, or by varying the lubrication, the grinding agent or the like, thereby also varying the magnitude of the angular oscillations of the spindle.

By forcing the brake block 41 against the spindle 10 the resistance offered to the spindle against rotation is increased and their angular oscillations are correspondingly reduced. If the spindle is stopped altogether by the brake, the tool will execute only a vertical reciprocating movement.

It will frequently be advantageous to machine a workpiece in such manner that at the beginning the tool is turned through large angles (by braking the sleeve 25), in order to quickly equalize the eccentric portions and the like which may be present, whereupon the brake acting on the sleeve is thrown out and the magnitude of the angular oscillations is merely determined by the automatic adjustment by the machine, depending upon the extent of polishing attained at any particular moment, and that finally the angular oscillations are gradually reduced, by braking the spindle, in such manner, that the last strokes are executed with the spindle fixed in position by the brake, i. e. without any oscillation of the tool.

After the polishing procedure has come to an end, the part 12 of the spindle can be lifted by means of the screw 13 and the tool withdrawn from the workpiece 20. Another workpiece may now be mounted in place in the machine and the part 12 of the spindle lowered into the correct position for work by turning the nut 13. The adjustable crank 5 enables the stroke of the slide 3 and spindle 10, 12 to be adapted to the equal length of the workpiece 20 to be machined.

In the modification illustrated in Fig. 3 the sleeve 25 is held against axial displacement in the hub 31 of the standard 1 by an anti-friction bearing 42 at one end and by a sliding bearing, formed by the smooth coacting surfaces of the flange 27 and hub 31, at the other end. Here again one of the bearings, in the present case the anti-friction bearing 42, offers less resistance to the rotation of the sleeve than the other (sliding) bearing.

I wish it to be understood that I do not desire to be limited to the exact details of construction shown and described for obvious modifications will occur to a person skilled in the art.

I claim:—

1. Polishing or honing machine comprising in combination, a standard, a sleeve rotatably supported in and secured against axial displacement relative to said standard and formed with a coarse internal threading, a tool carrier spindle formed with a corresponding external threading in gear with the threading in said sleeve and arranged for

axial reciprocation and for rotation and means arranged to oppose to said sleeve more resistance against rotation, when said spindle moves axially in one direction, than when said spindle moves axially in the opposite direction.

2. Polishing or honing machine comprising in combination, a standard, a sleeve rotatably supported in and secured against axial displacement relative to said standard and formed with a coarse internal threading, a tool carrier spindle formed with a corresponding external threading in gear with the threading in said sleeve and arranged for axial reciprocation and for rotation and checks associated with said sleeve which secure it against axial displacement and which are arranged to oppose to said sleeve more resistance against rotation, when said spindle moves axially in one direction, than when said spindle moves axially in the opposite direction.

3. The machine of claim 2, in which the checks form thrust bearings, one of which is formed with a smooth metallic sliding surface, and means between said sleeve and the other check having a higher friction coefficient than metal.

4. The machine of claim 2, in which the checks form thrust bearings, one of which is formed with a smooth metallic sliding surface, and an antifriction bearing between said sleeve and the other check.

5. Polishing or honing machine comprising in combination, a standard, a sleeve rotatably supported in and secured against axial displacement relative to said standard and formed with a coarse internal threading, a tool carrier spindle formed with a corresponding external threading in gear with the threading in said sleeve and arranged for axial reciprocation and for rotation and means for braking the rotating movement of said sleeve.

6. Polishing or honing machine comprising in combination, a standard, a sleeve rotatably supported in and secured against axial displacement relative to said standard and formed with a coarse internal threading, a tool carrier spindle formed with a corresponding external threading in gear with the threading in said sleeve and arranged for axial reciprocation and for rotation of said spindle and adjustable means for braking the rotating movement of said sleeve.

7. Polishing or honing machine comprising in combination, a tool carrier arranged for axial reciprocation and for rotation, means for causing rotation of said carrier in one sense during one axial stroke and in the opposite sense during the succeeding axial stroke, and automatically active means arranged to change the extent of angular movement of said carrier during alternating axial strokes.

8. Polishing or honing machine comprising in combination, a tool carrier arranged for axial reciprocation and for rotation, means for causing rotation of said carrier in one sense during one axial stroke and in the opposite sense during the succeeding axial stroke, automatically active means arranged to change the extent of angular movements of said carrier during alternating axial strokes and adjustable means for changing said alternating angular movements to an equal extent.

EDMUND HARTMANN.