

July 4, 1961

C. POUGNAND

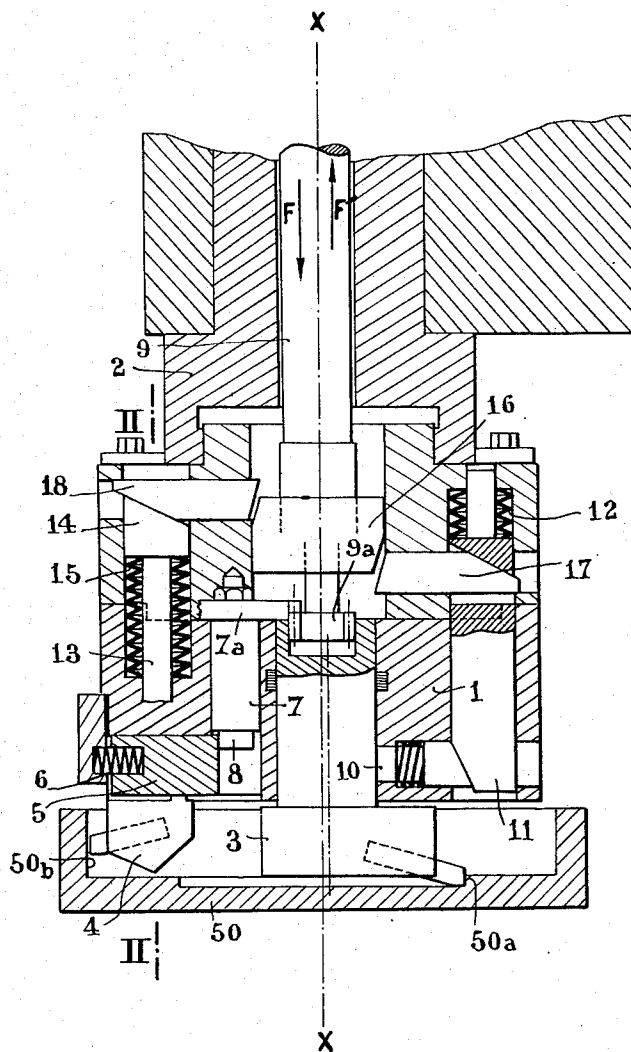
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SELF-ADJUSTING DEVICE FOR FINISHING TOOLS

Filed April 18, 1958

6 Sheets-Sheet 1

Fig.1.



July 4, 1961

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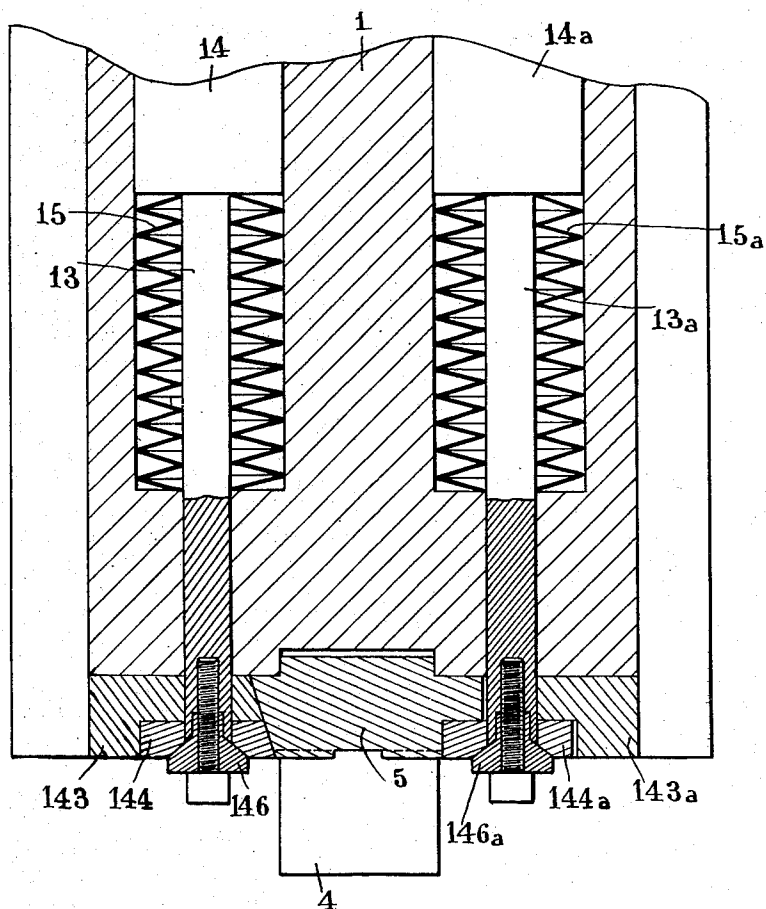
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Fig. 2.



July 4, 1961

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Filed April 18, 1958

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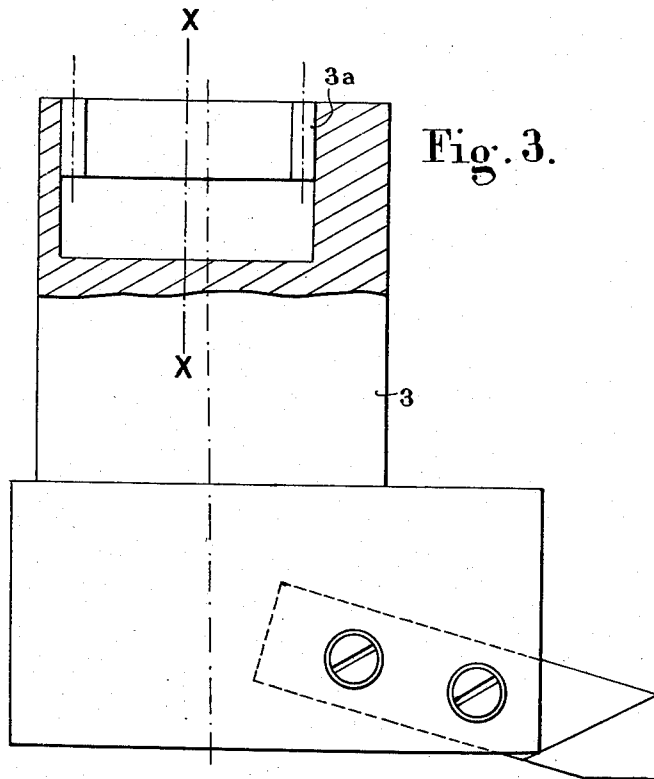


Fig. 3.

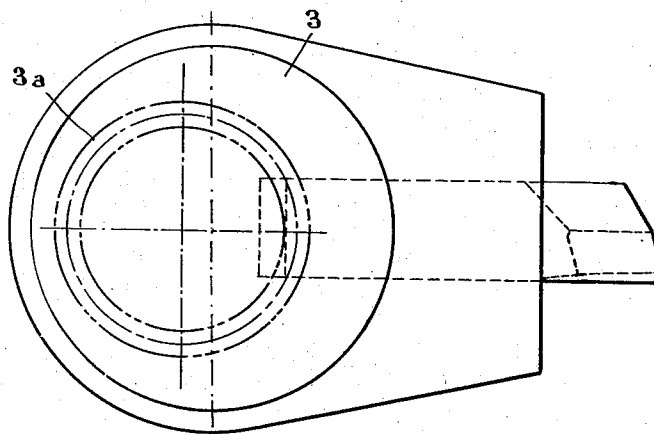


Fig. 4.

July 4, 1961

C. POUGNAND

2,990,730

SELF-ADJUSTING DEVICE FOR FINISHING TOOLS

Filed April 18, 1958

6 Sheets-Sheet 4

Fig.5.

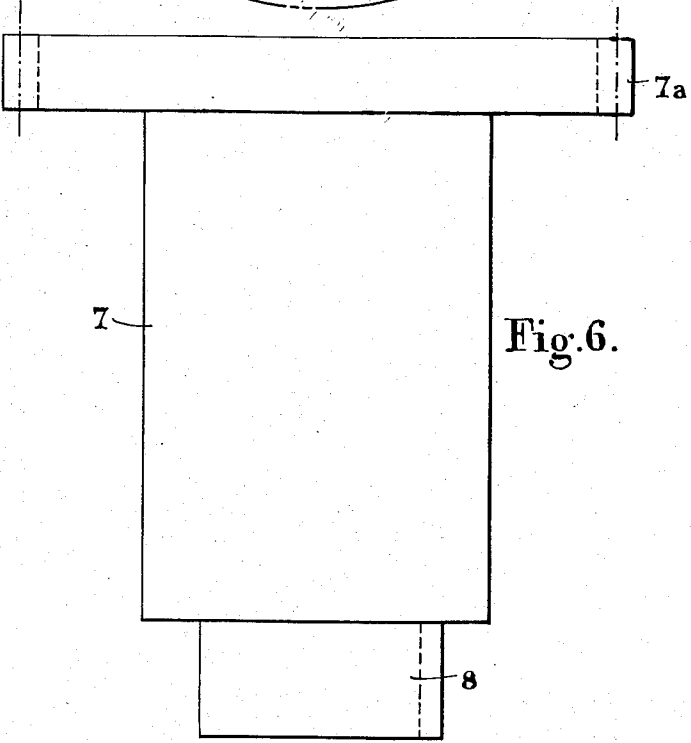
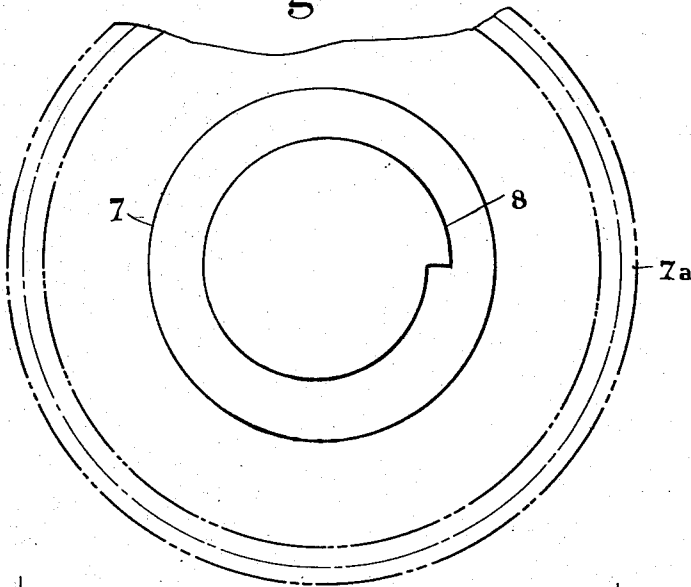


Fig.6.

July 4, 1961

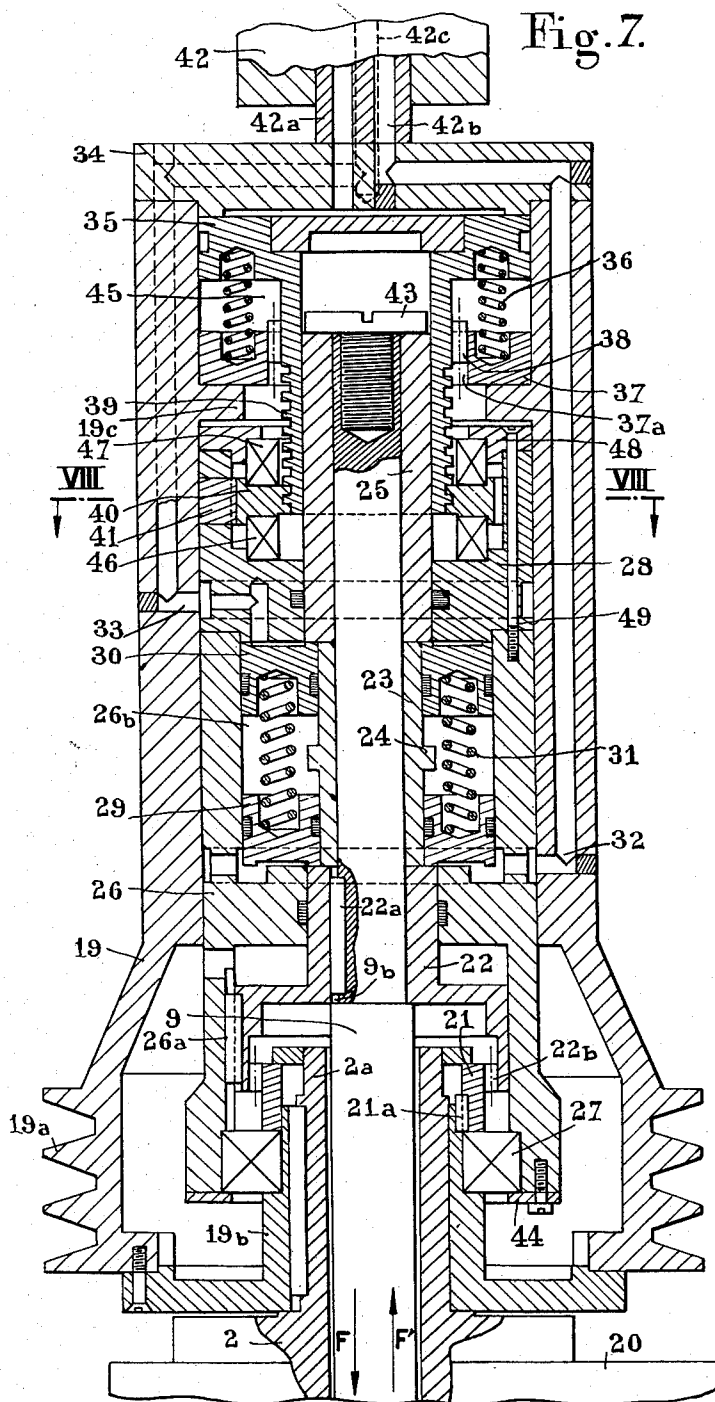
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SELF-ADJUSTING DEVICE FOR FINISHING TOOLS

Filed April 18, 1958

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July 4, 1961

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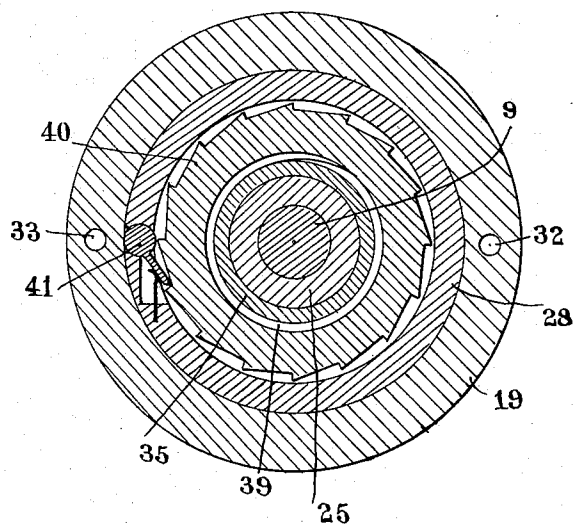
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SELF-ADJUSTING DEVICE FOR FINISHING TOOLS

Filed April 18, 1958

6 Sheets-Sheet 6

Fig.8



1

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SELF-ADJUSTING DEVICE FOR FINISHING TOOLS

Clément Pougnaud, Creteil, France, assignor to Societe Anonyme dite: Normacem, Paris, France

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6 Claims. (Cl. 77-4)

This invention relates in general to machine-tools and has specific reference to means for automatically adjusting the position of finishing tools on their tool holder during the operation of the machine-tool.

Tolerances for finishing workpieces are becoming increasingly smaller and this leads to more and more frequent re-adjustments of the tools utilized in finishing operations to compensate tool wear.

Now it is the essential object of this invention to provide a device adapted, in combination with adequate measuring means checking the size of the workpieces during their machining, to automatically adjust one or two tools carried by a common spindle, in order to displace these tools independently of each other to an extent consistent with the prescribed machining tolerances.

This automatic device comprises essentially a rod mounted in the spindle, responsive to a control apparatus, and adapted to perform on the one hand axial movements in either direction from an intermediate or middle position in order to cause said rod to move to another or extreme position in which it acts on a single tool holder while temporarily releasing said holder, and on the other hand rotational movements of adequate magnitude and direction, whereby the rod may alter the position of said holder, the latter being mounted with a view to reduce the displacements of the active or cutting portion of the tool to the minimum quantity required for effecting the necessary adjustment.

The operation of the device according to this invention is controlled by a measuring apparatus checking the dimension of the workpiece which results from the machining operation. When this dimension approaches one of the tolerance limits, the control apparatus receives from the measuring apparatus adjustment signals or data causing said control apparatus, with the assistance of the device, to bring the tool concerned to another position corresponding to the other limit of the tolerance.

Each tool holder may be mounted to permit the actuation of said rod by means of an eccentric, cam, ramp or like member.

In order to afford a clearer understanding of this invention and of the manner in which the same may be carried out in the practice, reference will now be made to the accompanying drawings forming part of this specification and illustrating diagrammatically by way of example a typical embodiment of the invention. In the drawings:

FIGURE 1 illustrates in longitudinal section a bore-turning spindle carrying two finishing tools or inserts and equipped with a self-adjusting device according to this invention, wherein the tool holders are actuated from the rod in two different manners, by an eccentric and by a cam, it being understood that the same arrangement may be provided for both tools;

FIGURE 2 is a section taken upon the line II—II of FIG. 1;

FIGURES 3 and 4 are an elevational view and a plane view respectively of the eccentric controlling the central tool holder;

FIGURES 5 and 6 are views corresponding to FIGS. 3 and 4 respectively and showing more particularly the cam for adjusting the peripheral tool holder;

FIGURE 7 is a longitudinal section illustrating an

2

apparatus for controlling the device illustrated in the preceding figures; and

FIGURE 8 is a section taken upon the line VIII—VIII of FIG. 7.

Referring first to FIG. 1, the tool-holder block 1 secured on the machine spindle 2 comprises a central tool holder 3 mounted in a bore slightly eccentric relative to the axis of rotation X—X of the spindle, and a peripheral tool holder 4 mounted on a prismatic slide 5 constantly urged by spring means 6 for engagement with a cam 8 solid with a pin 7 rotatably mounted in the block 1.

In the example illustrated the tools fitted in the tool holders 3, 4 are used for machining simultaneously the bores 50a and 50b respectively in workpiece 50. Obviously, in certain types of works only one tool may be used instead of the two illustrated.

The eccentric portion of the central tool holder 3 comprises on the inner side of the block 1 an internally-toothed portion 3a (see FIGS. 3 and 4). On the other hand, the pin 7 comprises at its inner end a pinion 7a (FIGS. 5 and 6).

A central rod 9 extends through, and is coaxial to, the spindle 2, and is formed with a toothed end 9a in meshing engagement with the inner teeth 3a of the tool holder 3 and also with the pinion 7a of pin 7. This corresponds to the middle position of the central rod 9. From this position the rod may be moved in an axial direction either towards the front end of the spindle or backwards. The rod 9 is mounted in appropriate bearings (not shown) and the aforesaid teeth form spur gears.

The tool holder 3 is locked by two pins 10, 11 in conjunction with spring washers 12 or the like.

The slide 5 carrying the tool holder 4 is mounted for sliding movement in guideways 143, 143a (FIG. 2), and locked against movement in these guideways by wedge members 144, 144a engaged by tapered bearing members 146, 146a carried by pins 13, 13a. These pins are solid with push members 14, 14a respectively and urged in the upward direction, as seen in FIG. 2, by spring washers or like resilient members 15, 15a engaging these push members.

The central rod 9 carries a cylindrical block 16 solid therewith and concentric thereto, which is disposed between two wedge members 17, 18 so as to engage one or the other of these members, according as the rod is moved in one or the other axial direction. The peripheral surface portions of this block 16 which are to engage the relevant faces of the wedge members 17, 18 are machined to present an adequate inclination corresponding to that of these faces. The wedge member 17 is arranged to move the pin 11 against the resistance of the spring washers 12. On the other hand, the wedge member 18 is arranged to move the push members 14, 14a against the resistance of the spring washers 15, 15a.

With this arrangement, the position of the tool holder 3 may be adjusted by displacing the rod 9 in the direction of the arrow F to the proper extent.

Due to this movement, the teeth 9a of rod 9 engage more deeply the internally-toothed portion 3a of the tool holder 3 and are therefore disengaged from the pinion 7a of pin 7. At the same time, the block 16 engages the wedge member 17 and moves the pin 11 to free the pin 10 which, with the assistance of suitable spring means, releases the tool holder 3.

Then, the rod 9 is rotated through an angle corresponding for example to the pitch of the aforesaid spur gears. By virtue of the eccentric arrangement explained hereabove, the distance between the operative end of the tool and the spindle axis X—X is altered. By properly selecting the eccentricity (shown with a great exaggeration in the drawing in order more clearly to show the principle

of the invention), for example .004", and the rotation, for example a few degrees, of the spindle, the tool movement may be reduced to an extremely low value, as usually required for compensating tool wear.

Then, the rod 9 is restored to its middle position. Its teeth will engage the pinion 7a of pin 7 without any difficulty as the latter did not move and the rod was rotated by the extent of only one tooth. At the same time, the central tool holder is locked again in its novel position of adjustment.

To adjust the position of the peripheral tool holder 4, the rod 9 is moved in the direction of the arrow F' and then rotated as required.

During this movement, the block 16 forming an integral part of the rod 9 has moved the wedge member 18 and thus the spring washers 15, 15a are compressed through the medium of the push members 14, 14a.

The pins 13, 13a solid with these push members 14, 14a respectively will thus release the tapered bearing members 146, 146a.

Under these conditions, the slide 5 of the tool holder 4 is free from its guideways 143, 143a and wedge members 144, 144a.

During its axial movement, the pinion 9a is disengaged from the pinion 3a of tool holder 3 but is still in meshing engagement with the lateral pinion 7a.

The rotational movement of block 16 causes the pin 7 to rotate and the cam 8 solid therewith changes in the proper direction the position of the slide 5 and tool holder 4.

By returning to its middle position the rod 9 permits the movement of the members 18, 14, 14a, 13 and 13a with the assistance of springs 15, 15a in a direction opposite to that of the preceding movement. Thus, the slide 5 is re-locked automatically.

The different movements of the rod are obtained with the assistance of a control apparatus mounted for example at the rod end opposite to the end carrying the tool holders. This apparatus may be actuated hydraulically, pneumatically, etc.

By way of non-limiting example, FIG. 7 shows a mechanical embodiment of this control apparatus which is adapted to be actuated from a source of compressed air.

The mechanical component elements of this apparatus are housed in a hollow sleeve 19 of which one portion 19a of the outer surface constitutes a pulley for driving the spindle 2. These component elements are shown in the position corresponding to the middle position of the rod 9.

Secured on the sleeve 19 and on the side of the headstock 20 is a hub 19b keyed on the hub 2a of the tubular shaft 2. The rod 9 extends freely through this hub. On the other hand, a pinion 21 is keyed at 21a on the hub 19b. On the extension of rod 9, between a shoulder 9b and an end bolt 43 are mounted a pinion 22 keyed on the rod 9 by means of a key 22a, a distance-piece 23 comprising an annular heel portion 24, and an end distance-piece 25. The pinion 22 has internal teeth 22b meshing with those of pinion 21.

Coaxially to the rod 9 is a cylinder 26 bearing with its lower end (that is, the end adjacent to the headstock 20) on the hub 19b of sleeve 19 through the medium of a ball-bearing 27 wedged on this hub and held in position by the stop washer 44. The cylinder 26 is keyed at 26a with pinion 22 so that the latter can slide axially relative to this cylinder. At its upper end, the cylinder 26 is closed by a member 28 whereby this cylinder, in conjunction with the ball-bearing 27, is held against axial movement. This cylinder 26 is formed with an annular recess 26b in which a pair of annular pistons 29, 30 held in proper spaced relationship by springs 31 are adapted to slide on the distance-piece 23. Compressed-air inlets 32 and 33 are provided for controlling the displacement of either of these pistons. Thus, when the piston 30 is pushed downwards, that is, toward the headstock 20, it engages the heel portion 24. From this moment on, it carries

along the distance-piece 23 and pinion 22, the latter sliding within the cylinder 26, and therefore the rod 9 proper (in the direction of the arrow F) since the pinion 22 engages the shoulder 9b of this rod. This movement is stopped when the heel portion 24 engages the piston 29. At this time, the pinion 22 is no more in meshing engagement with pinion 21.

The same movement but in the reverse direction (as shown by the arrow F') is obtained by actuating the other piston 29. Indeed, when compressed air is supplied through the inlet 32, the piston 29 moves upwards and compresses the springs 31 until the piston engages the heel portion 24. From this moment on the piston carries along the distance-piece 23 upwards, and through the medium of the other distance-piece 25 and of the end bolt 43 it moves the rod 9 in the direction of the arrow F'. In either case, when the supply of compressed air is discontinued, the springs 31 restore the pistons 29, 30 and rod 9 to their initial positions, respectively.

The upper end of sleeve 19 which is opposite to the headstock 20 is closed by a member 34 and therefore constitutes a cylinder 45 in which a piston 35 constantly urged to its uppermost position by springs 36 is slidably mounted, these springs bearing with their opposite ends on a member 37 engaging a collar 19c of sleeve 19. This piston 35 is rigid with straight splines 38 meshing with corresponding splines 37a formed on member 37, thus compelling said piston 35 to move in a direction parallel to the axis of rod 9 without revolving in relation thereto. Furthermore, this piston 35 carries helical teeth 39 in meshing engagement with corresponding helical teeth formed on the inner face of a ratchet wheel 40 held between a pair of thrust ball-bearings 46 and 47. The lower ball-bearing 46 is clamped between the member 28 and ratchet wheel 40, and the upper ball-bearing 47 is disposed between this ratchet wheel 40 and a check ring 48.

Meshing with the teeth of ratchet wheel 40 is a pawl 41 (FIG. 8) pivoted in a recess formed at the upper end of member 28. The check ring 48 is assembled with member 28 and cylinder 26 by means of the same fastening members, for example screws 49. The downward axial movement of piston 35 (when the upper face thereof is subjected to the pressure of the compressed air) will thus cause the ratchet wheel 40 to rotate in the clockwise direction (as seen in FIG. 8), this rotation being transmitted to member 28 and cylinder 26 through the medium of pawl 41. When the application of pressure to the upper face of piston 35 is discontinued, this piston is urged upwards by the return spring 36. During this movement the ratchet wheel 40 revolves in the counter-clockwise direction (FIG. 8) without carrying along the pawl 41 as the latter escapes the ratchet teeth in this direction.

The ratchet wheel 40 comprises as many external teeth (co-acting with the pawl 41) as there are teeth on pinions 3a, 7a, 21 and 22. The pitch of the helical teeth 39 of piston 35 is such that each properly limited movement of this piston toward the headstock causes a rotation of the ratchet wheel 40 and therefore of cylinder 26, pinion 22 and rod 9, this rotation corresponding to one pitch of any one of these four pinions.

A rotary three-way distributor 42 of the type comprising three separate passages 42a, 42b, 42c, for the compressed air is provided at the end of the sleeve 19 which is opposite to the headstock 20. The distribution of compressed air proper is controlled in turn by adequate means as will readily occur to anybody conversant with the art.

Besides, the apparatus and instruments provided for checking the sizes of the workpieces may be of any suitable and known type, provided that they are capable of converting their measurements into an average value producing control signals or like data adapted to be fed to said control apparatus but only when a pre-adjusted value is attained, this value being approached below the limit of the prescribed tolerance.

What I claim is:

1. A device for selectively adjusting the position of two tools mounted on two tool holders housed in a common spindle for finishing workpieces, said device comprising a member axially movable inside said spindle, means for driving said movable member in the axial direction on either side of a middle position to one or the other of two extreme positions, means for rotatably driving said movable member about its axis, other means for locking said tool holders against motion when said movable member is in its middle position and releasing one of said tool holders while maintaining the other one in its locked condition when said movable member is moved to one of its extreme positions, and means for producing a small radial movement of the released tool holder when said movable member is in its corresponding extreme position and rotated, in order to compensate for tool wear.

2. A device for selectively adjusting the position of two tools mounted on two tool holders housed in a common spindle for finishing workpieces, said device comprising a rod axially movable in said spindle, means for driving said movable rod in the axial direction from a middle position to one or the other of two extreme positions, means for rotatably driving said movable rod about its axis, a pinion solid with said rod, a first rotary member controlling the radial movement of a tool holder, a second rotary member controlling the radial movement of the other tool holder, each of said first and second rotary members comprising a set of teeth adapted to engage the teeth of said pinion when said movable rod is in its middle position, whilst only one of said sets of teeth is in meshing engagement with said pinion when said movable rod is in one of its extreme positions, means for locking said tool holders when said movable rod is in its middle position and unlocking one of said tool holders while maintaining the other tool holder in its locked condition when said movable rod is brought to one of its extreme positions, whereby when said movable rod is in one of its extreme positions and rotated about its axis said pinion may drive the rotary member with which it is in meshing engagement, said

rotary member producing in turn the radial movement of the relevant tool holder.

3. A device as set forth in claim 2, wherein said means for locking and unlocking said tool holders comprise a cylindrical block solid with said movable rod, and wedge members adapted to lock said tool holders in their position of adjustment, said wedge members being disposed on either side of the middle position of said cylindrical block and adapted to be selectively moved by said block for unlocking the relevant tool holder when said cylindrical block is moved to one of its extreme positions.

4. A device as set forth in claim 2, wherein each of said tool holders is eccentric relative to the rotary member on which it is mounted.

5. A device as set forth in claim 2, wherein one of said rotary members carries a cam, said tool holder being urged by resilient means against said cam.

6. A device as set forth in claim 1, wherein said means for axially and rotatably driving said movable member comprise a compressed-air distributor, a first, a second, and a third piston adapted to be moved in the axial direction by means of said compressed air selectively supplied by said distributor, said first and second pistons controlling respectively and selectively the axial movements of said movable member in one or the other of its extreme positions, said third piston controlling the rotation of said movable member, said compressed-air distributor being adapted to produce the rotation of said movable member only between two axial reciprocations of said movable member.

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