June 7, 1955 X. F. CASTELLI 2,709,924

ADJUSTING MECHANISM FOR MACHINE TOOLS

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Fig. 1.

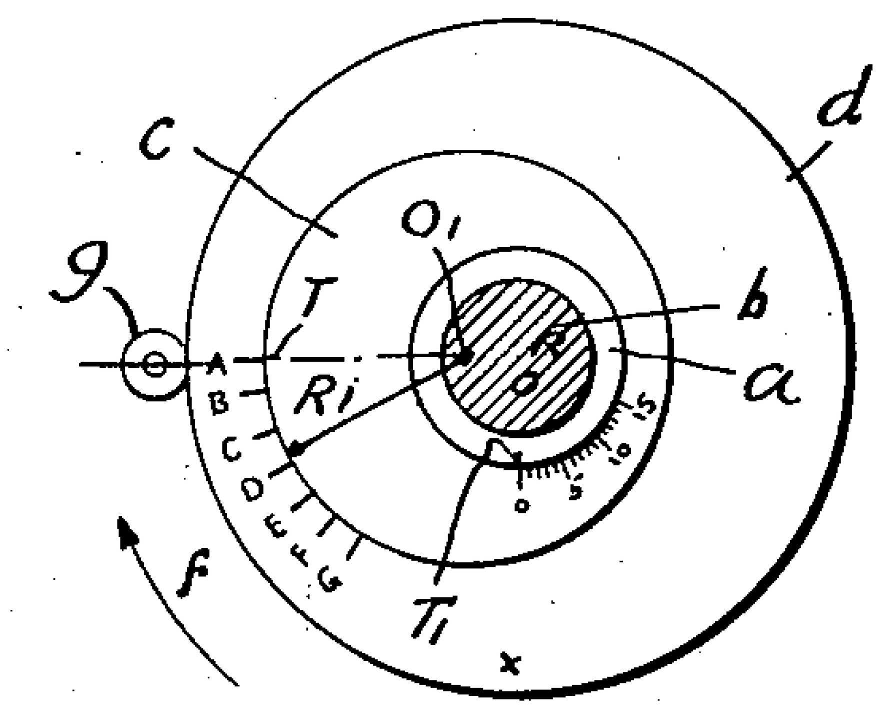

Fig. 2.

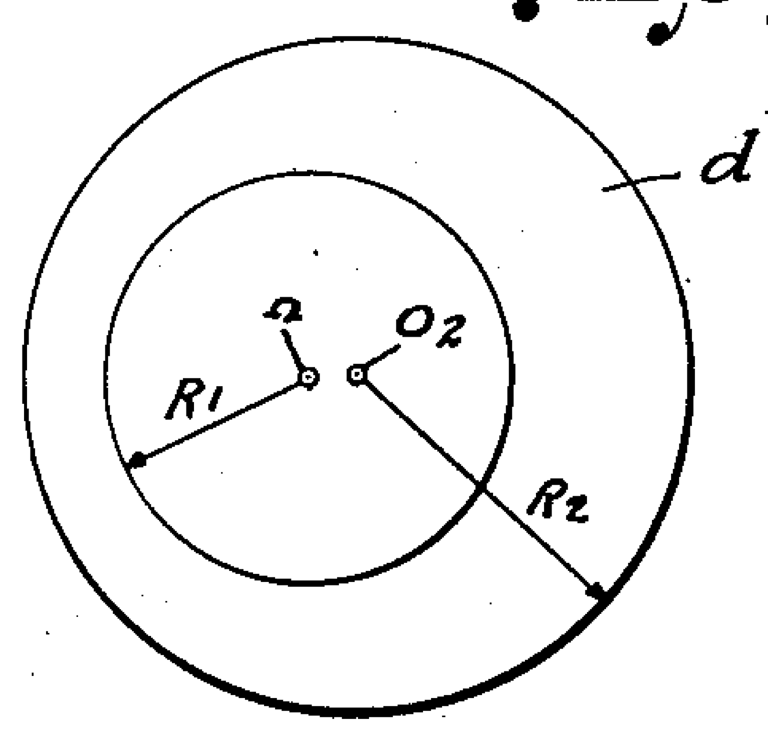

Fig. 3.

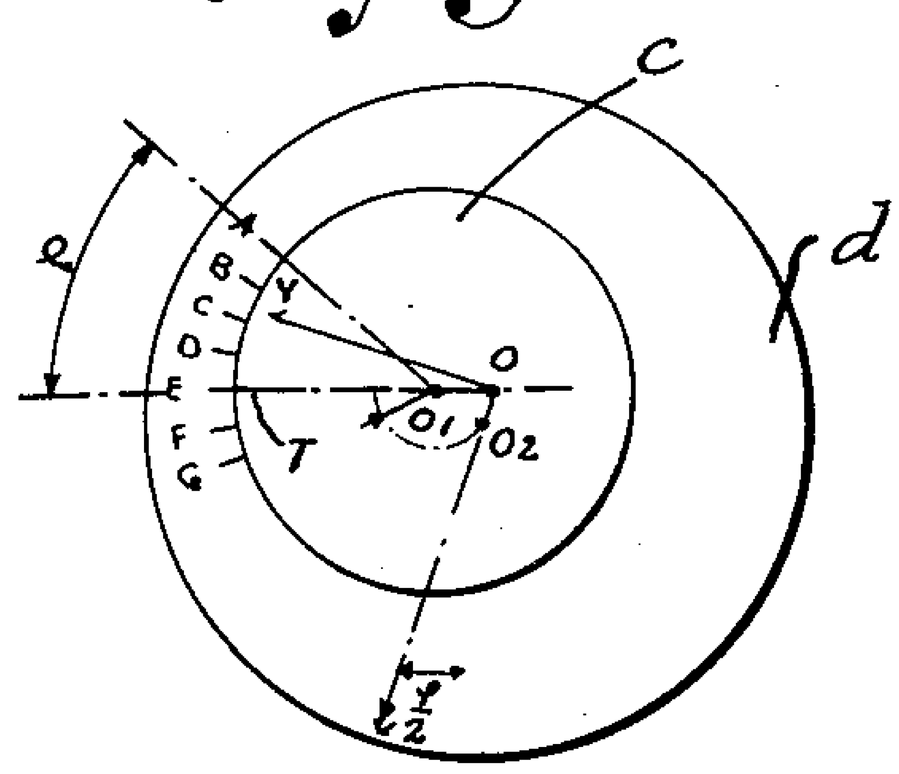

Fig. 4.

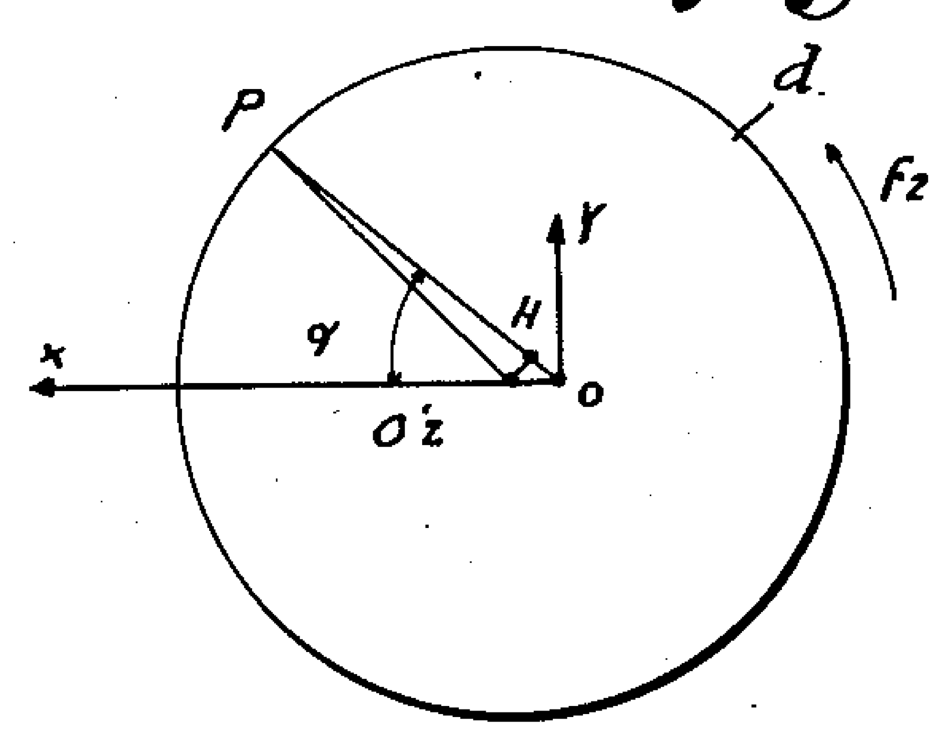

Fig. 7.

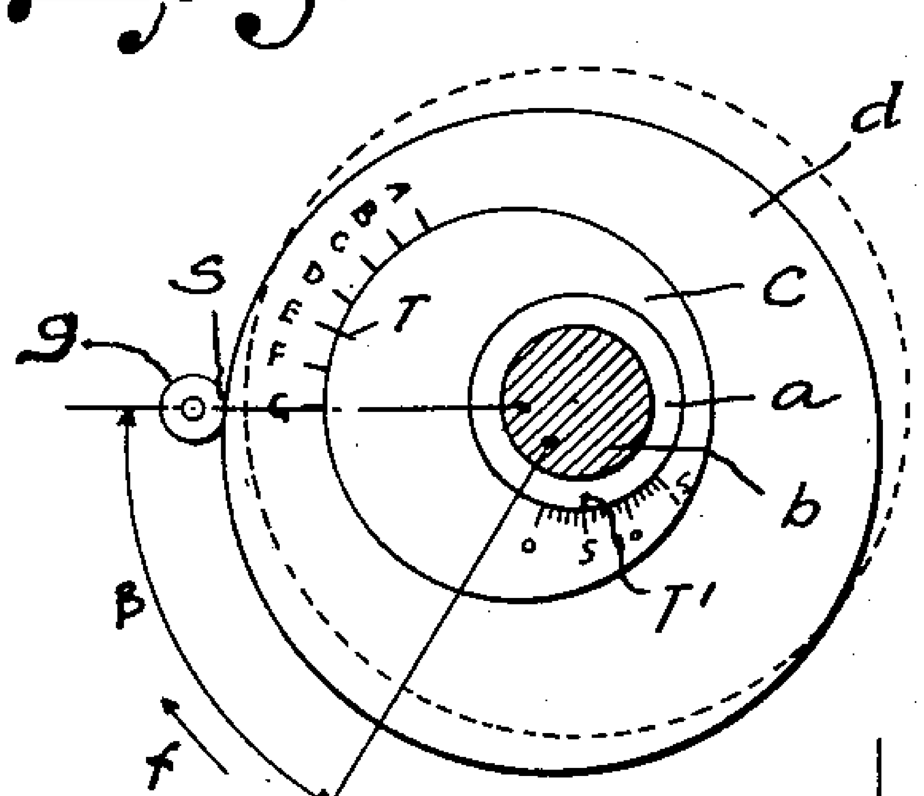

Fig. 5.

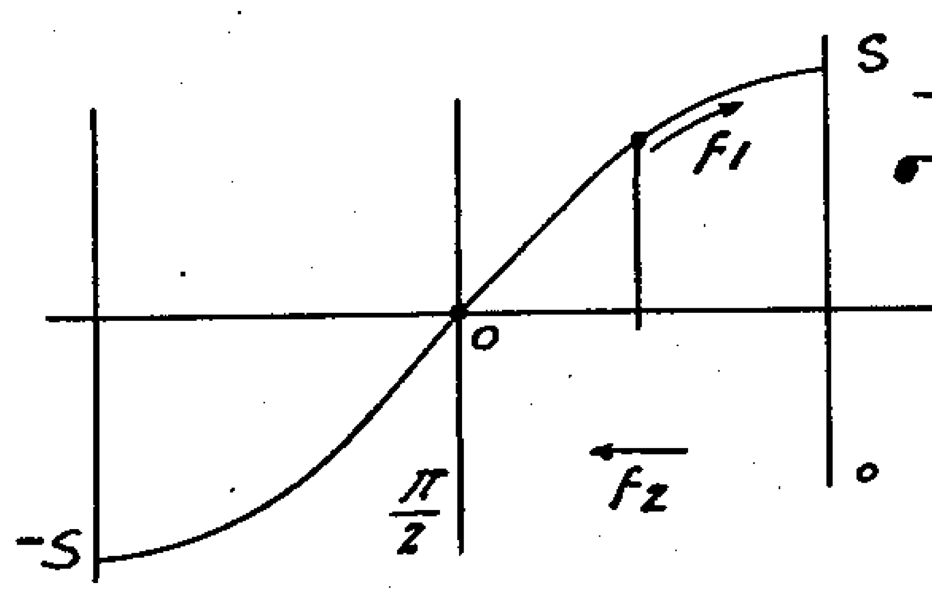

Fig. 6.

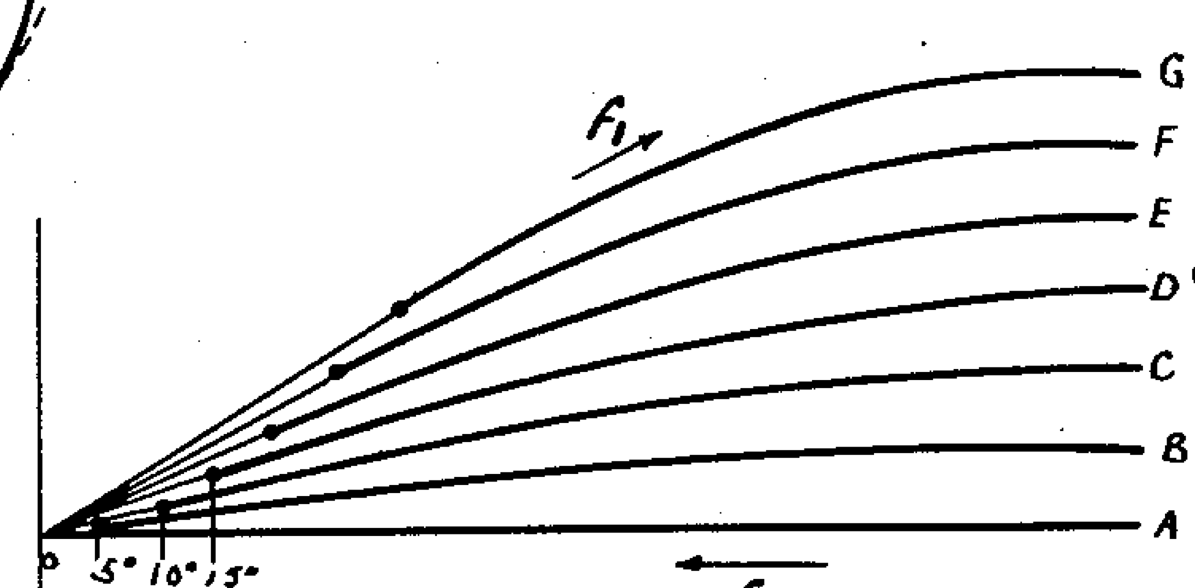

Fig. 8.

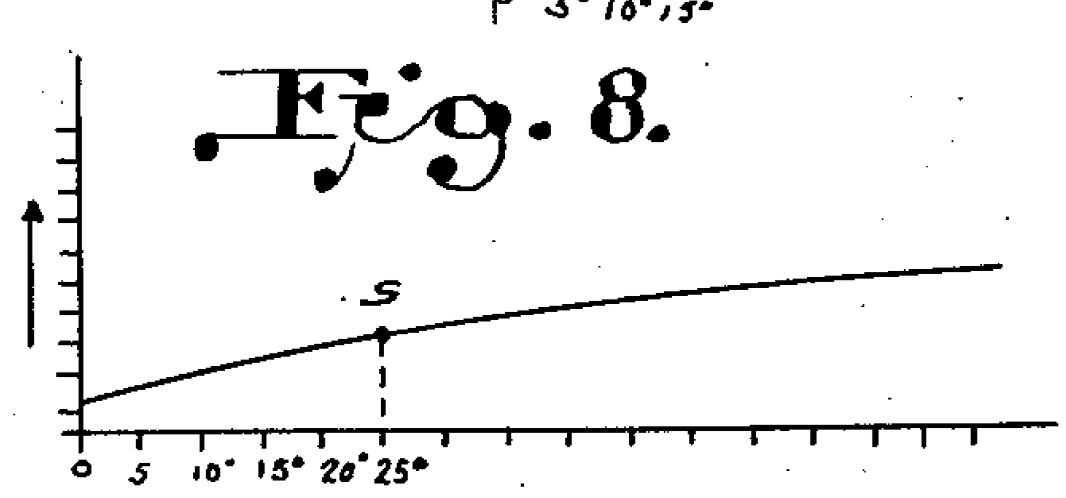

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Fig. 9.

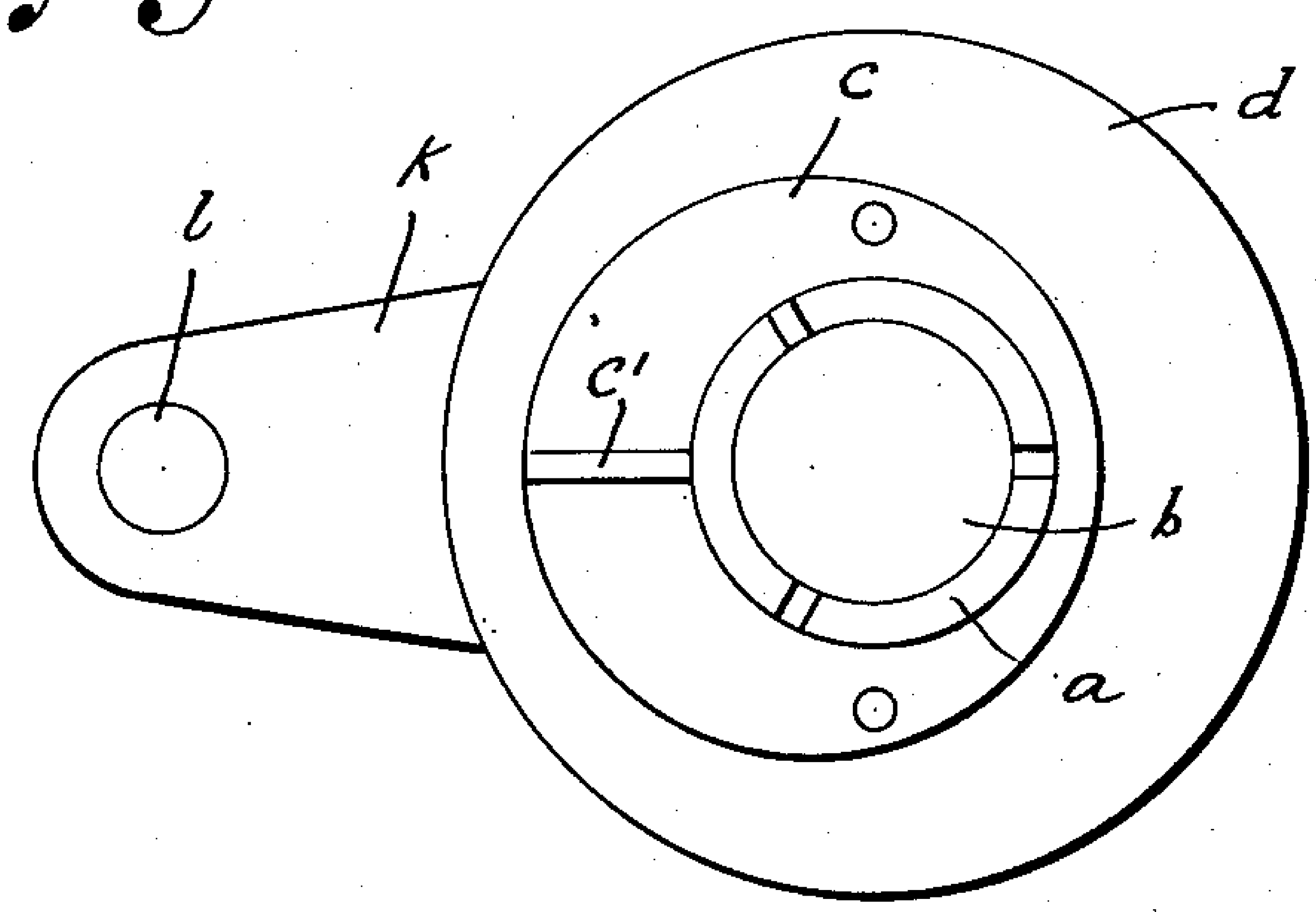


Fig. 10.

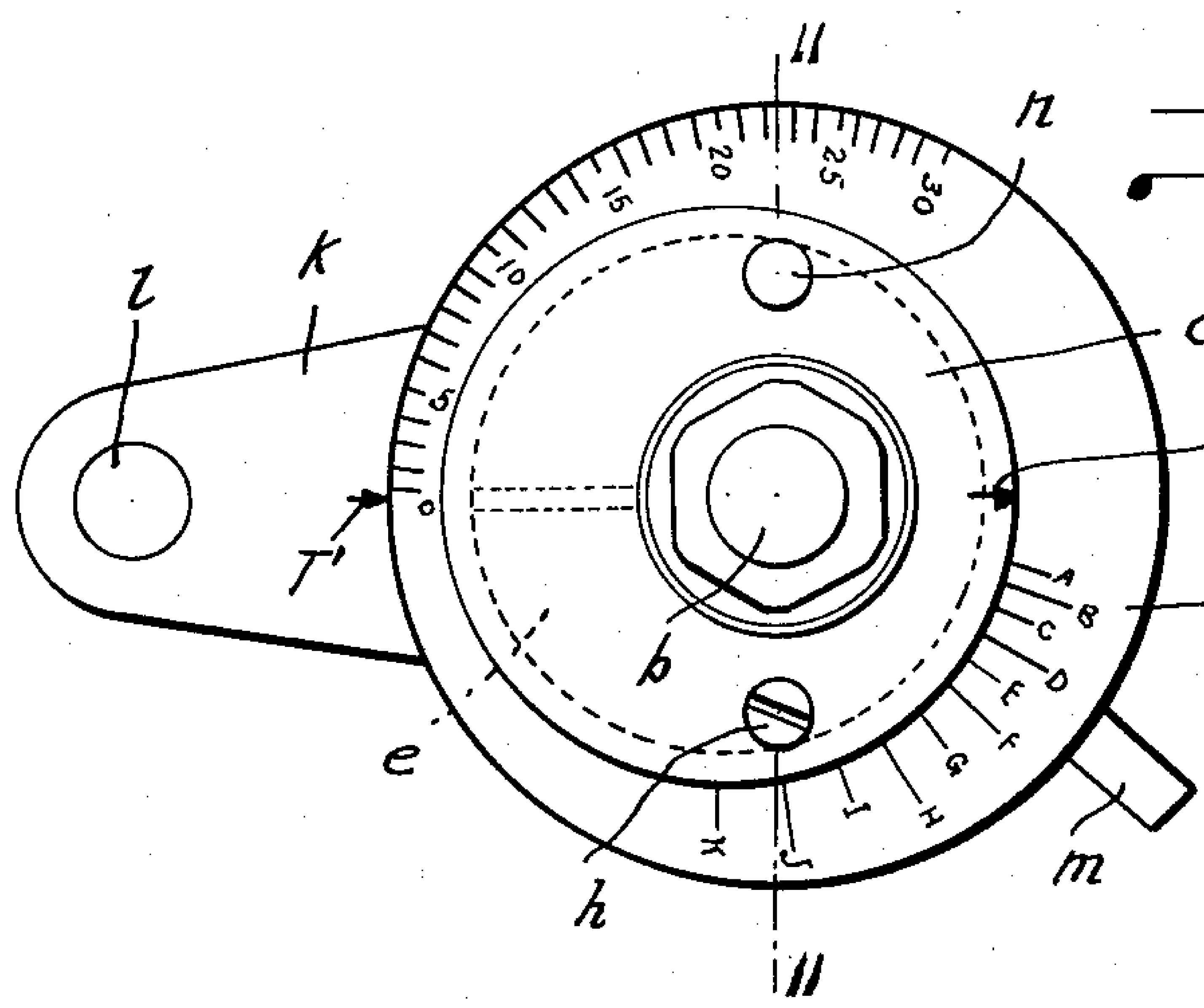
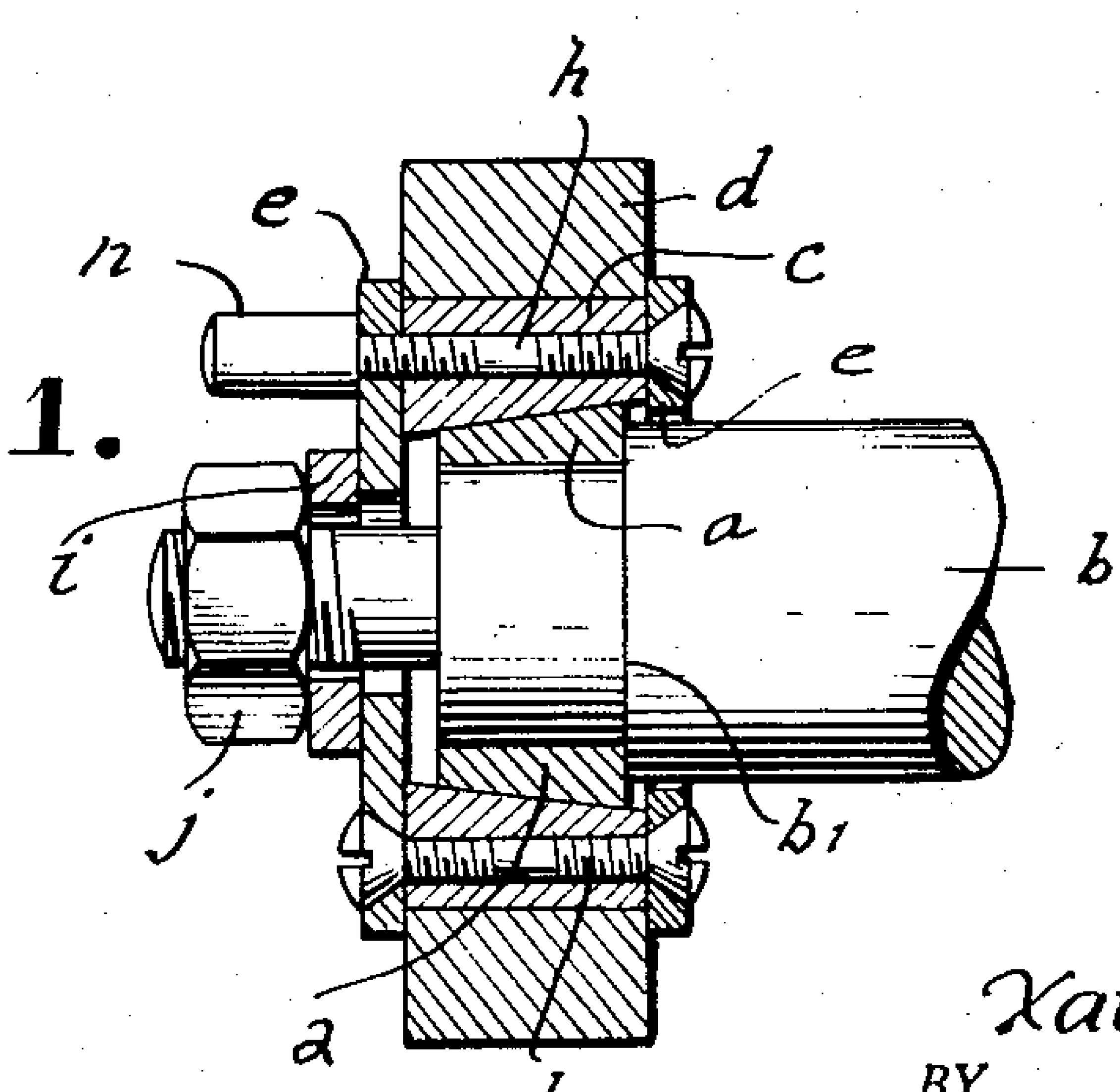


Fig. 11.



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2,709,924

ADJUSTING MECHANISM FOR MACHINE TOOLS

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Section 1, Public Law 690, August 8, 1946
Patent expires February 10, 1965

1 Claim. (Cl. 74—571)

The present invention has for its object a process for controlling the displacements of a mechanical member adapted to be moved by translation such as, more particularly, a tool holder, which process permits of transmitting to said member displacements of a variable amplitude with equally variable feed motion rates, without interposition of any step-up or step-down gear elements. The invention has also for its object an improved cam device embodying the principles of said process.

According to the invention a cam device rotatable by a cam shaft through an angle not exceeding 90° for imparting to the displaceable element a unidirectional feed motion of the character described comprises a pair of eccentrics of equal eccentricity of which the first, or inner eccentric is mounted on the cam shaft and second, or outer eccentric, on the inner eccentric, together with a feed imparting cam follower displaceable by the outer eccentric along a straight line passing through the cam shaft axis, the outer eccentric being angularly adjustable with respect to the inner for selectably varying the feed stroke by selectably varying the sinusoidal law according to which the feed proceeds.

On the other hand, by varying the setting angle of the inner eccentric with respect to the driving shaft, one can change, for a given sinusoidal law, the portion of the sinusoid which is actually effective for the control and, consequently, vary the feed motion rate of the controlled member.

The process according to the invention finds a particularly interesting application in the control of the transversal feeding movements of the tool in horizontal tool lathes and especially in screw-cutting machines working with a tool. Indeed, the sinusoidal law according to which the rotation of the cam device is transmitted to the feed motion of the tool makes it possible, through a connection, which can easily be performed mechanically, of said rotation with the longitudinal movement of the tool, to obtain successive cuts of decreasing depths, as required for a rational execution of the work, while the possible variation of the starting point of the working arc of the cam device for a given adjustment of the outer profile of the same allows for any modification of the relation between the depth of the first cuts (rough cutting) and that of the last cuts (finishing). By combining the mechanisms for the control of the cam rotation and longitudinal displacement of the tool with a mechanism allowing a variation between given limits of the number of cuts in which the total feed motion of the tool must be effected, it is then possible, through simple adjustments, to adapt this number of cuts, for the same pitch of the thread, to the nature of the metal to be worked upon, by choosing according to the requirements of the work a relative depth which is more or less reduced for the last cuts.

The improved cam device embodying the principles of the above described process comprises, as previously stated, two eccentrics of an identical eccentric ratio, mounted one onto the other and both clamped on the same driving shaft, and is substantially characterized by adjusting means adapted to settle independently the angular position of the outer eccentric with respect to the inner eccentric, and of the inner eccentric with respect to the driving shaft, both adjustments permitting of varying, on the one hand, the amplitude of displacement of the controlled member, and, on the other hand, the feed motion rate of said displacement. Means are provided to indicate the relative angular positions of the eccentrics and the driving shaft.

In a practical embodiment of this invention, the inner eccentric is clamped onto the driving shaft by means of a conical helving and comprises a radial slot which allows said inner eccentric expanding in the bore of the outer eccentric, the whole being clamped onto the driving shaft by means of a nut or like organ. For adjusting the relative angular positions of the outer eccentric with respect to the inner eccentric and of the latter with respect to the driving shaft, it is only necessary to unscrew the nut and to rotate each eccentric of the desired angle, and then to screw said nut. Controlling fingers or rods may advantageously be connected with each eccentric to allow said double adjustment being more easily effected.

Other particularities of the invention will appear from the following description of an embodiment thereof with reference to the appending drawing, given merely by way of non-limitative examples, and in which

Figure 1 is a diagrammatic elevational view of the cam device according to the invention in the neutral position of the two eccentrics;

Figure 2 is a similar view of the outer eccentric of said cam device;

Figures 3 to 8 are explanatory views and diagrams showing the use of such a cam device;

Figure 9 is an elevational view of one embodiment of the cam device in the original position corresponding to Figure 1, the nut and the cheeks of the outer eccentric being removed;

Figure 10 is a view similar to Figure 9 of the cam device entirely built up;

Figure 11 is a cross sectional view, through line XI—XI of Figure 10.

In the diagrammatic example of Figure 1, the variable cam device embodying the principle of this invention consists of a circular central body *a* with a radius R and center O, clamped onto a shaft *b*, the axis of which goes through O. On the body *a* is mounted a first eccentric ring *c*, the outer outline of which is a circumference with a radius R_1 and center O_1 and which comprises a bore with a radius R and center O allowing it turning about the body *a*. On the ring *c* is mounted a second eccentric *d*, the outer outline of which is a circumference with a radius R_2 and center O_2 (Figure 2) and which comprises a bore with a radius R_1 and center Ω. Eccentric *d* can rotate about eccentric *c*, the center Ω of its bore permanently coinciding with center O_1 of the outer outline of eccentric *c*. The eccentric ratio $O_2\Omega$ of eccentric *d* is equal to eccentric ratio O_1O of eccentric *c* so that there is one and only one position for which O_2 coincides with O, the outer outline of eccentric *d* then being centered on shaft *b* and the cam device being a circle of a radius R_2 concentric to said shaft. This position is shown in Figure 1.

On eccentric *d* are marked graduations A, B, C . . . spaced, for instance, at angular intervals of 5°, and on eccentric *c* is provided a reading index T which, in the above defined neutral position in which the outline of ring *d* is concentric with the rotation axis of shaft *b*, registers with graduation A. When a setting angle φ is given to eccentric *d* with respect to eccentric *c* (Figure 3), the center O_2 is shifted on a circumference with the center O_1 and the radius $r=O_1O$ and comes at O'_2.

The shape now taken by the outer outline of the cam device with respect to two rectangular axes Ox, Oy in Figure 3 can be defined by means of Figure 4. Supposing, in this latter figure, a point P moving on the outer circumference of eccentric d, the distance OO'_2 is small with respect to O'_2P (R_2). When the perpendicular O'_2H is dropped on OP, admitting by way of approximation, that $PO'_2=PH$ and setting $OO'_2=\delta$, one has:

$$OH=\delta \cos \alpha$$

wherefrom one can deduce

$$OP=R_2+\delta \cos \alpha$$

The trajectory of point P during the rotation of the cam device about the center O is, therefore, a curve with a sinusoidal variation. Supposing that the cam device rotates, for instance, in front of a reproducing roller g compelled to shift in the direction OO_1 in Figure 1, when the cam device rotates in the direction of the arrow f, the displacements of roller g can be read on a sinusoid such as that which is shown in Figure 5, in the direction indicated by the arrow f_1, the arrow f_2 indicating the positive direction of angles. The length $OO'_2=\delta$ which defines the maximum amplitude of such displacements depends on the number of divisions A, B, C . . . brought above the mark T, i. e. on the angle φ of Figure 3. The value of δ with respect to radius r of eccentricity is given by the relation:

$$\delta=2\,r \sin \frac{\phi}{2}$$

The adjustment of the position of the outer eccentric d on eccentric c allows, therefore, imparting to the reproducing roller g displacements along sinusoidal abscissae with a variable coefficient ($\delta \cos \alpha$), δ being variable at will between predetermined limits. It is thus possible to establish, as to said displacements of roller g, a group of curves such as that shown in Figure 6 for the different points of adjustment A, B, C . . . and so on.

On the other hand, angular graduations 0, 5, 10 . . . are also marked on the inner eccentric c, opposite which a reading mark T′ is provided on the body a. In the neutral position, as shown in Figure 1, mark T′ is opposite the graduation 0. It is obvious that if a certain setting angle is given to eccentric c with respect to body a by rotating said eccentric about the latter (Figure 7), the sinusoidal curve obtained through the preceding adjustment defined by graduations A, B, C . . . is not deformed, but the origin of the displacements of roller g is changed. For instance, on a curve such as that which is shown in Figure 8, and determined by a certain setting of the outer eccentric d, an angular adjustment of eccentric c, corresponding to a setting angle of 25° defines a position S for the origin of the working arc of the roller.

In the embodiment of Figures 9 to 11, the cam device comprises a central body a which is constituted by a conical sleeve in three parts and is clamped on the end of a shaft b fitted with a shoulder b_1. Said conical part could be formed on the shaft b itself. The inner eccentric c is hollowed with a conical bore which allows for said eccentric being clamped on sleeve a, and is slotted at c_1 in its widest part so that it possesses the greatest possible elasticity. The inner eccentric c is hollowed with a conical bore which allows for said eccentric being clamped on sleeve a, and is slotted at c_1 in its widest part so that it possesses the greatest possible elasticity. The inner eccentric c is itself surrounded by an outer eccentric d of identical eccentric ratio and which is maintained in position by means of two cheeks e fastened on eccentric c by means of screws h. The whole is clamped onto the shaft b by means of a washer and a locking nut j, advantageously of long thread, screwed on the end of said shaft.

The reproducing organ, adapted to transmit the cam action, for instance, to the tool holder of a screw cutting

machine, is constituted here by a sector k fitting the outline line of outer eccentric d and which is pivotally mounted onto a shaft l supported by an organ (not shown) in relation with the tool holder. The working line of the piece k is formed by the alignment of the centers of the pivot l and shaft b.

In order to adjust the angular position of the outer eccentric d with respect to the inner eccentric c, which position determines the choice of the sinusoidal law according to which the displacement of the reproducing organ will be controlled, a controlling rod m is fastened laterally on said eccentric d. The relative angular positions of d and c are marked, for instance, by means of a graduation formed of letters carried by the eccentric d opposite an index T carried by the outer cheek e. Another controlling rod n, formed, by way of example, by a lengthening of one of the screws h, allows controlling the angular position of inner eccentric c with respect to the shaft b, which position determines the part of the sinusoid which is actually effective for controlling the displacement of the reproducing organ. A graduation with figures carried by eccentric d in front of an index T′ carried by the piece k allows determining the position thus imparted to eccentric c. By screwing the nut j, both eccentrics may be clamped in every desired position, owing to the elasticity of eccentric c being distended by the conical sleeve a.

This application constitutes a continuation in part of my application Serial No. 622,166, filed October 13, 1945, now abandoned, entitled "Adjusting Method and Mechanism for Machine Tools."

What I claim is:

An apparatus for predetermining the feeding movements of the working instrument of a machine tool throughout its working cycle comprising a rotatable shaft operatively driven by the machine, a control cam rotatable with said shaft and adapted to impart feeding movements to said working instrument, said control cam including a pair of eccentrics one mounted within the other and the inner eccentric being mounted on the rotatable shaft, the outer eccentric being angularly adjustable relative to the inner eccentric for determining the sinusoidal law of tool feeding movements and the inner eccentric being angularly adjustable with respect to the shaft for determining the point on the sinusoid at which feeding movements commence, and means for clamping said eccentrics on the shaft in their adjusted position, said clamping means comprising a conical sleeve adapted to be secured between the shaft and the inner eccentric, plates fixed to opposite sides of the inner eccentric and engaging the sides of the outer eccentric for militating against relative axial movements of said eccentrics, and screw means on the shaft to impart axial movement to said sleeve relative to the inner eccentric.

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