April 13, 1937. S. A. STRICKLAND 2,076,682

GRINDING MACHINE

Filed Sept. 28, 1931 4 Sheets-Sheet 1

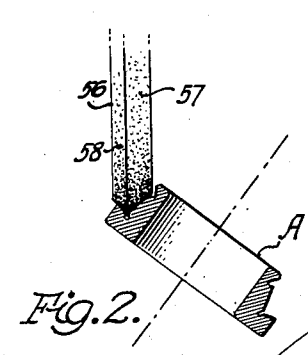


Fig. 2.

Fig. 1.

INVENTOR

Silas A. Strickland,

BY

ATTORNEYS

April 13, 1937. S. A. STRICKLAND 2,076,682

GRINDING MACHINE

Filed Sept. 28, 1931 4 Sheets-Sheet 2

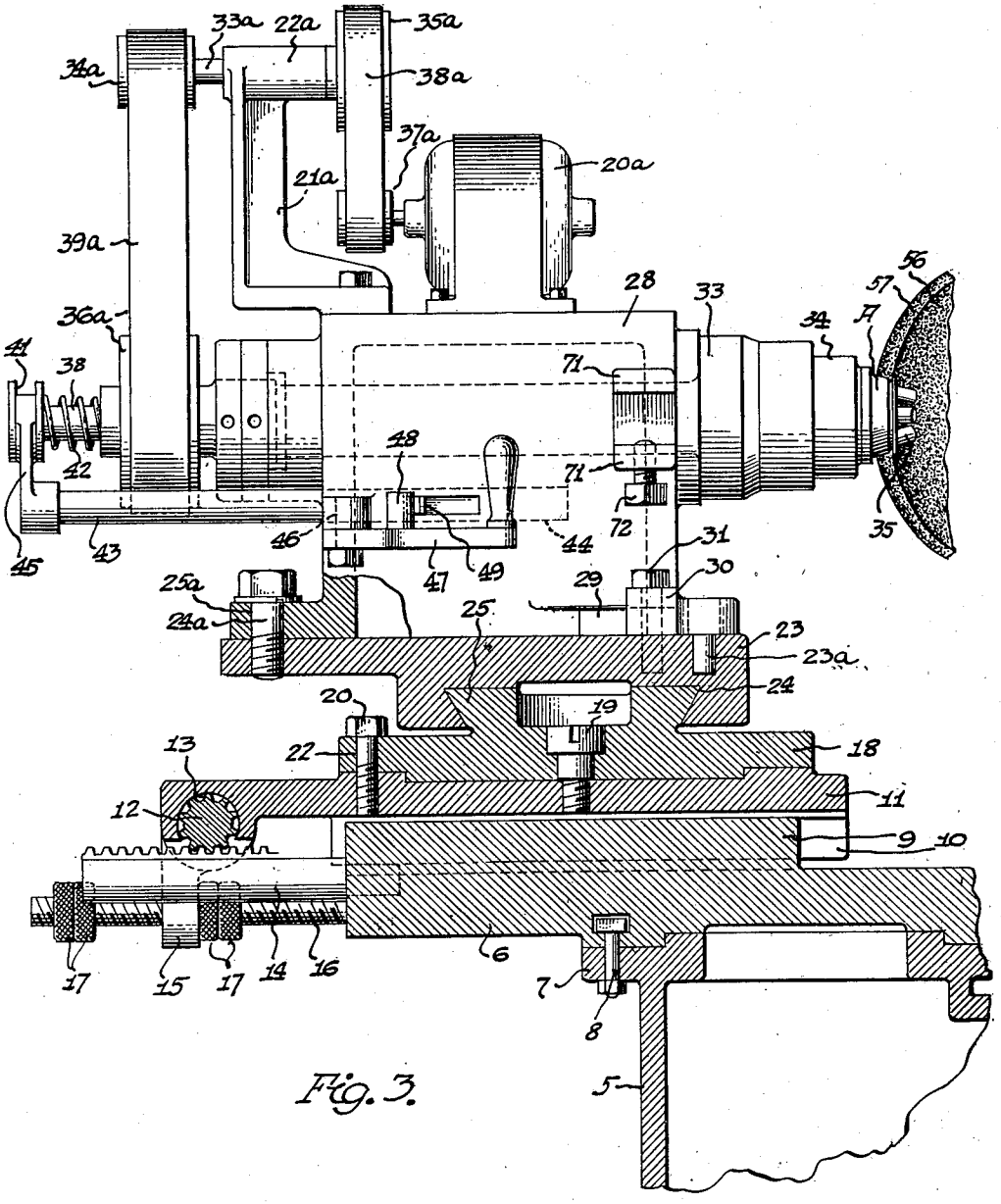


Fig. 3.

INVENTOR

Silas A. Strickland,

BY

ATTORNEYS

April 13, 1937. S. A. STRICKLAND 2,076,682

GRINDING MACHINE

Filed Sept. 28, 1931 4 Sheets-Sheet 3

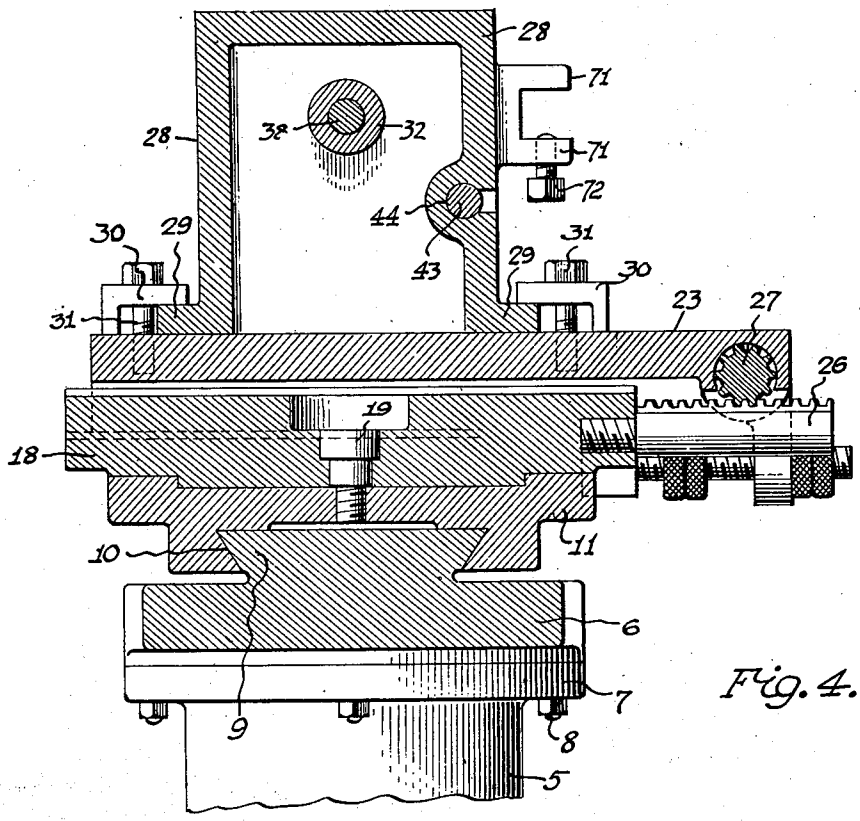


Fig. 4.

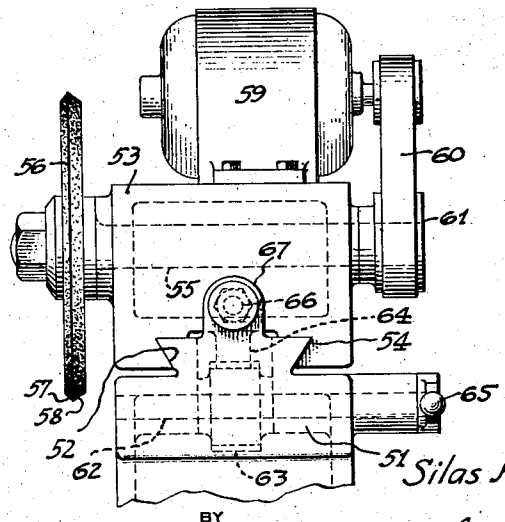


Fig. 5.

INVENTOR

Silas A. Strickland,

BY

ATTORNEY

April 13, 1937. S. A. STRICKLAND 2,076,682

GRINDING MACHINE

Filed Sept. 28, 1931 4 Sheets-Sheet 4

Fig. 8.

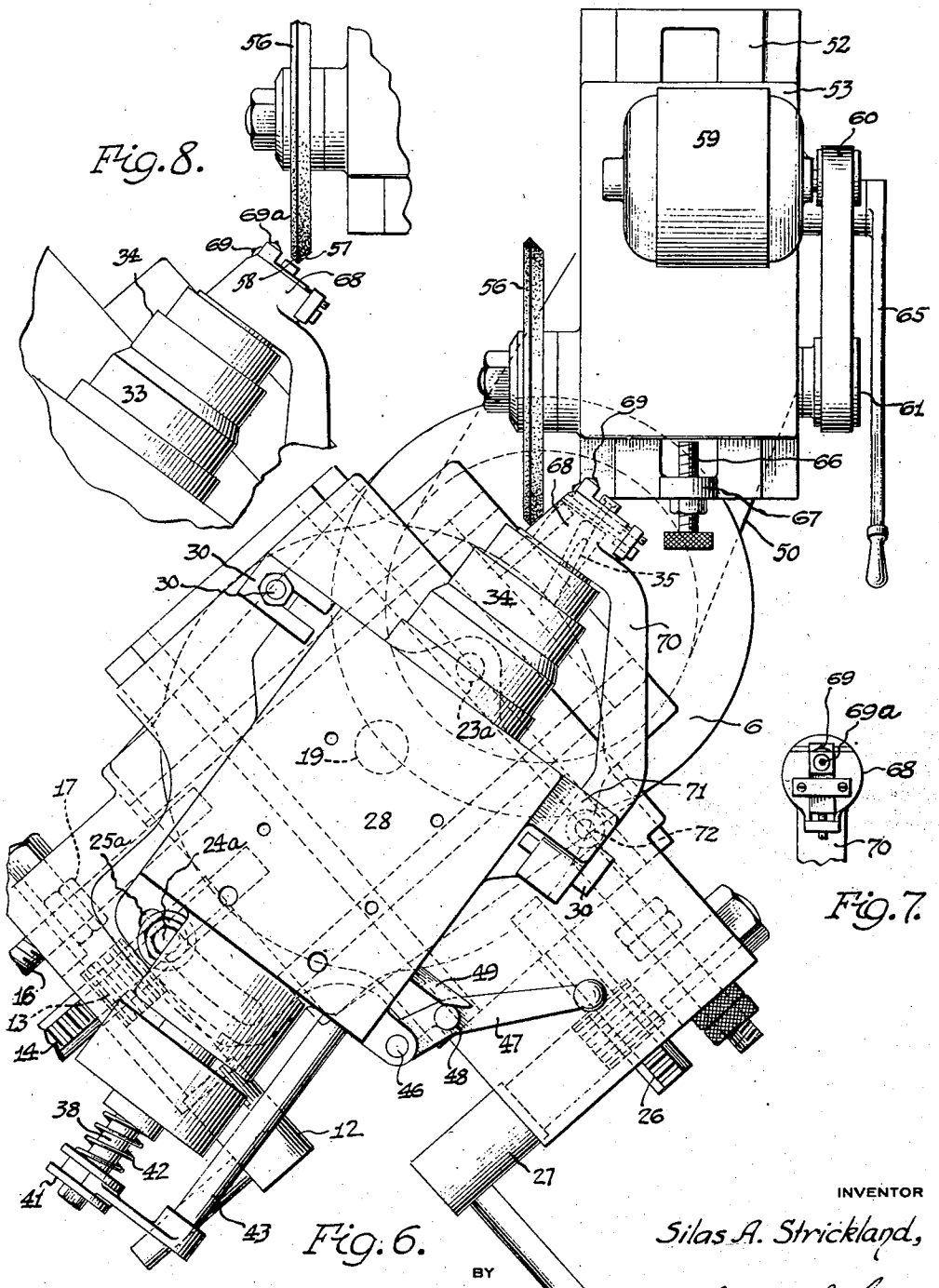


Fig. 6.

Fig. 7.

INVENTOR

Silas A. Strickland,

BY

ATTORNEYS

Patented Apr. 13, 1937

2,076,682

UNITED STATES PATENT OFFICE

2,076,682

GRINDING MACHINE

Silas A. Strickland, Detroit, Mich.

Application September 28, 1931, Serial No. 565,714

19 Claims. (Cl. 51—105)

My invention relates to grinding machines and has particular reference to a machine of this character for grinding the inner race or cone of anti-friction bearings.

An object of the present invention is to provide a grinding machine wherein two angularly disposed surfaces of a bearing member may be ground simultaneously.

Further the invention provides a machine of this character which embodies a work-holder which is manually adjustable to bring the work to a position where the angularly disposed faces thereof will be in proper relation to the angularly disposed faces of a grinding element.

It is another object of the invention to provide a grinding machine wherein the work-holder may be utilized as a support for a diamond dressing tool thus permitting the machine to be utilized to dress the grinding element when the surfaces of the latter have become worn.

The invention also contemplates a work-holder embodying a plurality of cooperating fingers which positively hold the work in place and having means for disengaging the fingers from the work after the latter has been operated upon.

With the preceding and other objects and advantages in mind the invention consists in the novel combination of elements, constructions, arrangements of parts and operations to be hereinafter specifically referred to, claimed and illustrated in the accompanying drawings, wherein—

Figure 1 is a top plan view of my improved grinding machine and having parts broken away;

Fig. 2 is an enlarged detail view showing the relation of the surfaces of the grinding element to the angular faces of the work;

Fig. 3 is a view of the machine partly in vertical section and partly in elevation;

Fig. 4 is a vertical section;

Fig. 5 is a front end elevation of the motor driven grinding element embodied in the invention;

Fig. 6 is a view similar to Fig. 1, and showing the diamond dressing tool held by the work-holder to dress the grinding element;

Fig. 7 is a detail view of the diamond dressing element, and

Fig. 8 is a detail view showing the dressing element in position to be adjusted to engage the outer surface of the grinding element.

Referring to the invention in detail a vertical tubular standard or base 5 is provided and mounted thereon is a bed plate 6, the latter being secured to an annular flange 7 on the base by clamping bolts 8. The upper face of the bed plate is formed with a dove-tailed tongue or track 9 which slidably receives a longitudinally extending dove-tail groove 10 formed in the under face of a longitudinally shiftable carriage 11. In order to shift the carriage a manually rotatable shaft 12 is journaled in the outer end of the carriage and extends transversely of the under face thereof and is provided with a pinion 13. Attached to the outer end of the bed plate 6 and projecting laterally therefrom and extending beneath the pinion 13 is a rack bar 14 whose teeth are engaged by the pinion 13. It will be seen that rotation of the pinion 13 in the required direction will shift the carriage forwardly or rearwardly on the bed plate. Longitudinal movement of the carriage is limited by an ear 15 which is received on a threaded rod 16 projecting from the outer end of the bed plate and which is equipped with adjustable stops or nuts 17 upon opposite sides of the ear.

Mounted on the upper face of the carriage is a disk or circular plate 18 which has its upper face formed with a dove-tail tongue 25 that extends at right angles to the dove-tail tongue 9.

Arranged on the disk 18 and adapted for longitudinal movement in a direction at right angles to the carriage 11 is a second carriage 23, the latter having a dove-tail groove 24 in its under face which receives the dove-tail tongue 25. The carriage 23 is adjusted by means of a rack bar 26 and a manually rotatable pinion 27 in the same manner as the carriage 11.

The carriage 23 is arranged to support a work-holder or chuck and for that purpose a substantially rectangular casting or mounting 28 is arranged upon the carriage 23. Lateral flanges 29 are formed on the lower edge of the casting or mounting which are engaged by anchoring clips 30 which in turn are anchored to the carriage by bolts 31.

For the purpose of adjusting the work-holder to dispose the surfaces of the work in proper relation to the angularly disposed faces of a grinding wheel to be hereinafter referred to the casting 28 is mounted on the carriage 23 for adjustment about a vertical pivot 23a. The casting is normally held against turning on the pivot 23a by means of a set screw 24a engaged with the carriage 23 and passing through an arcuate slot 25a provided in the rear end of the casting.

In order to grind the surface of the work to any desired angle, the disk 18 is rotatably connected to the carriage 11 by a central vertically extending pivot 19. It will be seen that the entire structure above the carriage 18 may be swung to any desired position about the axis 19 until the surfaces of the work are parallel to the grinding surfaces of the grinding wheel. Normally, the plate 18 is held fixed by means of a bolt 20 which is threaded into the carriage 11 and passes through an arcuate slot 22 at one edge of the disk.

The chuck or work-holder comprises a sleeve 32 which extends longitudinally through the mounting and projects from the ends thereof.

The forward end of the sleeve terminates in a collar 33 in which a head or chuck 34 is held. Arranged for longitudinal movement within the head 34 is a plurality of cooperating angularly disposed fingers 35 each of which is urged in a forward direction to project from the head by an expansible coiled spring 36. As shown particularly in Fig. 1, the projecting ends of the fingers are formed with notches or seats 37 in their outer faces which support the anti-friction member A while the same is being ground.

In order to hold the fingers 35 in a position where the seats 37 will engage and hold the anti-friction member, a longitudinally shiftable rod 38 is arranged within the sleeve 32 and is provided with a head 39 at its inner end which is engaged by a lug 40 formed on the inner end of each of the fingers. The opposite end of the rod projects from the sleeve and carries a grooved collar 41. Encircling this outer end of the rod is a coiled spring having one end abutting the collar and its opposite end abutting the adjacent end of the sleeve and normally urges the rod in a direction to hold the head 39 against the lugs 40 of the fingers 35. It will therefore be seen that the head 39 limits the movement of the fingers so that they will only project far enough to engage their seats 37 with the anti-friction member.

Means are provided for manually shifting the rod against the action of the spring 42 to advance the head 39 and permit the fingers 35 to project further from the head so that their seats 37 will move away from the anti-friction member and permit the same to be moved. For this purpose a manually shiftable rod 43 is arranged parallel to the rod 38 and has one end received in a longitudinal guide 44 in one side of the mounting 28. The opposite end of this rod 43 carries a yoke 45 which is engaged with the grooved collar 41. Mounted on one side of the mounting 28 for movement about a vertical axis 46 is a hand lever 47 carrying an upstanding lug 48 which is disposed in the path of movement of a laterally extending arm 49 fixed to the inner end of the rod 43 and which projects laterally through the mounting 28.

It will be seen that movement of the lever 47 towards the mounting 28 will engage the lug 48 with the arm 49 and move the latter forwardly. This in turn shifts the rod 43 forwardly in its guide and through the yoke 45 shifts the rod 38 forwardly and disengages the head 39 from the lugs 40. With the head 39 thus advanced the springs 36 will function to project the fingers 35 to a point where their seats 37 will move away from the anti-friction member. However, with the fingers in the normal position shown in Fig. 1, the anti-friction member will be effectively held in position for grinding.

An electric motor 20a is mounted on the upper wall of the casting 20 for driving the chuck or work-holder. Also supported on the casting at a point to one side of the motor is an upstanding bracket 21a provided with a bearing sleeve 22a in which a shaft 33a is journaled. Pulleys 34a and 35a are carried by the shaft and are in operative relation to pulleys 36a and 37a attached to the chuck and motor respectively. Power is transmitted from the motor to the shaft 33a by means of a drive belt 38a engaging the pulleys 35a and 37a. A second drive belt 39a is engaged with the pulleys 34a and 36a to drive the chuck.

Cast with the standard 5 and extending laterally therefrom at a point substantially diametrically opposite the bed plate 6 is a horizontally extending arm or shelf 50 and formed integral therewith is a substantially rectangular casting 51. The upper face of the casting 51 is formed with a longitudinally extending dove-tailed tongue 52. A carriage 53 is mounted for longitudinal adjustment on the casting 51 and is provided with a dove-tailed groove 54 which slidably embraces the dove-tailed tongue 52.

Extending transversely through the forward end of the casting 51 and journaled therein is a shaft 55 which carries a grinding wheel 56. As shown particularly in Fig. 2 the grinding wheel 56 is formed with right angularly extending grinding surfaces 57 and 58 which coincide with the angular surfaces of the anti-friction member so as to grind the two angular surfaces of the latter simultaneously.

An electric motor 59 is mounted on the carriage 53 and engaged with the driven shaft thereof is an endless belt 60 which engages a pulley 61 on the adjacent end of the shaft 55 and thereby drives the grinding member 56.

In order to shift the carriage 53 a shaft 62 extends transversely through the carriage below the motor and is equipped with a pinion 63 which engages a rack bar 64 fixed to the carriage. The shaft 62 is equipped with a hand lever 65 for rotating the shaft to adjust the carriage. The carriage is limited in its forward movement by an adjustable set screw 66 which is mounted in an upstanding ear 67 formed on the forward end of the casting 51.

In the operation of the invention the work to be ground being held on the fingers 35 the carriages 11 and 23 are first adjusted longitudinally and laterally until the surfaces of the work coincide with the grinding surfaces of the grinding wheel 56. The rotating grinding wheel 56 is now brought into contact with the work by movement of the carriage 53 forwardly through the medium of the lever rotated pinion 64. As each piece of work is ground it is only necessary to back up the grinding wheel by movement of the carriage 53 rearwardly. It will be observed that after the carriage has been initially set it will be unnecessary to disturb the adjustment and due to this adjustment all the pieces of the work will be ground to the same degree.

The invention proposes utilizing the chuck to support a suitable resurfacing tool in position for resurfacing the grinding surfaces of the grinding wheel after they have become worn. As shown in Figure 6 the resurfacing tool is in position preparatory to bringing the diamond 69 into contact with the inner face of the grinding wheel. In Figure 8 the device is in position preparatory to bringing its diamond 69a into contact with the outer surface of the wheel.

For cooperation with the fingers 35 of the chuck in holding the resurfacing tool in position, the latter is provided with a rearwardly curved arm 70 which extends to one side of the casting 20 and lies between a pair of outstanding parallel ears 71 formed on one of the side walls of the casting. A set screw 72 is carried by one of these ears and is normally engaged with the arm 70 to hold the same against movement.

What I claim is:

1. In a grinding machine, wherein the grinding tool is adapted to concurrently grind adjacent member faces having the general relation of approximate right angles to produce an included angle characteristic therebetween, and where-

in the faces are each substantially conical with respect to the axis of the member forming the work, and in combination, a longitudinally adjustable carriage, a rotatable grinding element supported thereon, said element being mounted for bodily movement in a fixed path toward and from the work grinding position, and a chuck supported at one side of the grinding wheel and adjustable longitudinally and transversely, said chuck being also mounted for pivotal adjustment on a plurality of independent vertical axes.

2. In a grinding machine, wherein the grinding tool is adapted to concurrently grind adjacent member faces having the general relation of approximate right angles to produce an included angle characteristic therebetween, and wherein the faces are each substantially conical with respect to the axis of the member forming the work, and in combination, a longitudinally adjustable carriage, a rotatable grinding element supported thereon, said element being mounted for bodily movement in a fixed path toward and from the work grinding position, a chuck supported at one side of the grinding wheel and adjustable longitudinally and transversely, means for adjusting the chuck relative to a plurality of independent parallel vertical axes whereby to dispose the work carried thereby in proper angular relation to the grinding surface of the grinding wheel, and means for removably retaining the work on the chuck in such adjusted position, said latter means being operative to position and release the work while retaining the chuck in its adjusted position.

3. In a grinding machine, wherein the grinding tool is adapted to concurrently grind adjacent member faces having the general relation of approximate right angles to produce an included angle characteristic therebetween, and wherein the faces are each substantially conical with respect to the axis of the member forming the work, and in combination, a longitudinally shiftable carriage, a rotatable grinding element attached thereto and rotatable about a horizontal axis, said element being mounted for bodily movement in a fixed path toward and from the work grinding position, a support arranged in advance of the grinding wheel, a horizontally arranged chuck mounted on the support and capable of both transverse and longitudinal adjustment, means for adjusting the chuck relative to a plurality of independent parallel vertical axes so that the surfaces of the work carried thereby will be in proper angular relation to the surfaces of the grinding wheel.

4. In a grinding machine, wherein the grinding tool is adapted to concurrently grind adjacent member faces having the general relation of approximate right angles to produce an included angle characteristic therebetween, and wherein the faces are each substantially conical with respect to the axis of the member forming the work, and in combination, a longitudinally shiftable carriage, a rotatable grinding element attached thereto and rotatable about a horizontal axis, said element being mounted for bodily movement in a fixed path toward and from the work grinding position, a support arranged in advance of the grinding wheel, a horizontally arranged chuck mounted on the support and capable of both transverse and longitudinal adjustment, means for adjusting the chuck relative to a plurality of independent parallel vertical axes so that the surfaces of the work carried thereby will be in proper angular relation to the surfaces of the grinding wheel, and means for adjusting the support whereby the work may be ground to any desired pitch.

5. In a grinding machine, wherein the grinding tool is adapted to concurrently grind adjacent member faces having the general relation of approximate right angles to produce an included angle characteristic therebetween, and wherein the faces are each substantially conical with respect to the axis of the member forming the work, a support, a longitudinally adjustable carriage mounted thereon, a rotatable grinding element supported by the carriage, said element being mounted for bodily movement in a fixed path toward and from the work grinding position, a work-holder arranged on the support at substantially diametrically opposite the carriage, means for adjusting the work-holder longitudinally towards the grinding element, and means for adjusting the work-holder transversely towards the grinding element, said chuck being also adjustable relative to a plurality of independent parallel vertical axes.

6. In a grinding machine, wherein the grinding tool is adapted to concurrently grind adjacent member faces having the general relation of approximate right angles to produce an included angle characteristic therebetween, and wherein the faces are each substantially conical with respect to the axis of the member forming the work, a support, a longitudinally adjustable carriage mounted thereon, a rotatable grinding element supported by the carriage, said element being mounted for bodily movement in a fixed path toward and from the work grinding position, a work-holder arranged on the support at substantially diametrically opposite the carriage, means for adjusting the work-holder longitudinally towards the grinding element, means for adjusting the work-holder transversely towards the grinding element, and means for adjusting the work-holder to dispose the work in proper angular relation to a grinding element, said latter means including independent adjustments relative to a plurality of independent parallel vertical axes.

7. In a grinding machine, wherein the grinding tool is adapted to concurrently grind adjacent member faces having the general relation of approximate right angles to produce an included angle characteristic therebetween, and wherein the faces are each substantially conical with respect to the axis of the member forming the work, a base, a longitudinally and transversely adjustable mounting on the support, and a work supporting chuck supported in the mounting for pivotal adjustment thereon on a vertical axis, said mounting including a pivotal adjustment on a vertical axis intermediate the longitudinal and transverse adjustments thereof.

8. In a grinding machine, wherein the grinding tool is adapted to concurrently grind adjacent member faces having the general relation of approximate right angles to produce an included angle characteristic therebetween, and wherein the faces are each substantially conical with respect to the axis of the member forming the work, a base, a longitudinally and transversely adjustable mounting on the support, a work supporting chuck supported in the mounting for pivotal adjustment thereon on a vertical axis, said mounting including a pivotal adjustment on a vertical axis intermediate the longitudinal and transverse adjustments thereof, a motor sup-

ported by the mounting, and driving means between the motor and chuck.

9. In a grinding machine, wherein the grinding tool is adapted to concurrently grind adjacent member faces having the general relation of approximate right angles to produce an included angle characteristic therebetween, and wherein the faces are each substantially conical with respect to the axis of the member forming the work, a base, a longitudinally shiftable carriage mounted thereon, a second carriage mounted on the first mentioned carriage for adjustment transversely thereof, a pivotal connection between said carriages to permit relative adjustments therebetween on a vertical axis, a mounting on the last mentioned carriage, a pivotal connection between said mounting and its supporting carriage to permit relative adjustment therebetween on a vertical axis, and a work supporting chuck journaled in the mounting.

10. In a grinding machine, wherein the grinding tool is adapted to concurrently grind adjacent member faces having the general relation of approximate right angles to produce an included angle characteristic therebetween, and wherein the faces are each substantially conical with respect to the axis of the member forming the work, a base, a longitudinally shiftable carriage mounted thereon, a second carriage mounted on the first mentioned carriage for adjustment transversely thereof, a pivotal connection between said carriages to permit relative adjustments therebetween on a vertical axis, a mounting on the last mentioned carriage, a pivotal connection between said mounting and its supporting carriage to permit relative adjustment therebetween on a vertical axis, a work supporting chuck journaled in the mounting, a motor supported from the mounting and a driving means between the motor and chuck.

11. In a grinding machine, wherein the grinding tool is adapted to concurrently grind adjacent member faces having the general relation of approximate right angles to produce an included angle characteristic therebetween, and wherein the faces are substantially conical with respect to the axis of the member forming the work or a plane normal to such axis, said machine including a base, a work-holding chuck, and means for adjusting said chuck rectilinearly and pivotally on said base to dispose work carried by the chuck in proper angular relation to the grinding tool of a grinding instrumentality, said means including independent carriages each movable in a predetermined straight line path angular with respect to the path of the other, and means for operatively connecting said carriages pivotally to permit variations in the relative angularity of the paths, one of said carriages supporting the chuck.

12. A machine as in claim 11 characterized in that means are provided for pivotally adjusting the position of the chuck on its supporting carriage with the pivot axis non-alined with the axis of pivotal connection between the carriages.

13. A machine as in claim 11 characterized in that the chuck includes work-supporting elements shiftable between work-supporting and work positioning and releasing positions while retaining the adjustments of the chuck relative to the base.

14. A machine as in claim 11 characterized in that the chuck includes work-supporting elements shiftable between work-supporting and work positioning and releasing positions while retaining the adjustments of the chuck relative to the base, the movement of the elements between such positions being in directions angular to the axis of the work.

15. A machine as in claim 11 characterized in that the connecting means for the carriages includes a mounting element carried by one of the carriages and pivotally connected adjustably therewith on a vertical axis, said element carrying a way co-operative with a complemental way carried by the second carriage to define the straight line path of the latter.

16. A machine as in claim 11 characterized in that the connecting means for the carriages includes a mounting element carried by one of the carriages and pivotally connected adjustably therewith on a vertical axis, said mounting element and the second carriage carrying complemental means operative to define the straight line path of the second carriage, said chuck having an adjustable pivotal connection with the second carriage on a vertical axis non-alined with the pivot axis of the mounting element.

17. In a grinding machine for the production of race or cone members of taper roller bearings, wherein the race or cone member presents a pair of adjacent roller-engaging faces angularly related at approximate right angles with said faces having conical characteristics relative to the axis of the member or a plane normal to such axis, a grinding instrumentality including a rotatable grinding tool having its active grinding zone shaped to concurrently grind both faces of the member when member and tool are brought into co-operative relation, and a work-supporting instrumentality adapted to position the bearing member with the member axis angular to the path of rotation of the tool, said work-supporting instrumentality including a work-supporting chuck, a base, and elements therebetween co-operative to support the chuck on the base and permit pivotal and rectilinear adjustments of the chuck relative to the base with said adjustments including rectilinear adjustments longitudinally and transversely and pivotal adjustments on two independent vertical axes, whereby the angularity of member axis and tool path of rotation and the distance characteristic of axis and path is variable at will to permit production of members differing in dimensional characteristics.

18. A machine as in claim 17 characterized in that the active zone of the grinding tool presents its grinding faces as angular to a plane normal to the axis of tool rotation with the faces differing in radial length and angularly related to each other in correspondence with the angularity of the included angle of the pair of member faces, the relation of member and tool during grinding presenting the tool faces as inclined and non-parallel with the member axis or a plane normal to the member axis.

19. A machine as in claim 17 characterized in that the grinding tool is movable in a rectilinear path between active and inactive positions with the adjusted chuck maintained in position to locate the member in the active position of the tool, whereby the angularity and distance characteristics of work axis and tool path remain constant in the grinding of successive members.

SILAS A. STRICKLAND.