Feb. 8, 1927. **1,617,167**

C. SCHRAMM

GRINDING MACHINE

Filed May 25, 1922 3 Sheets-Sheet 1

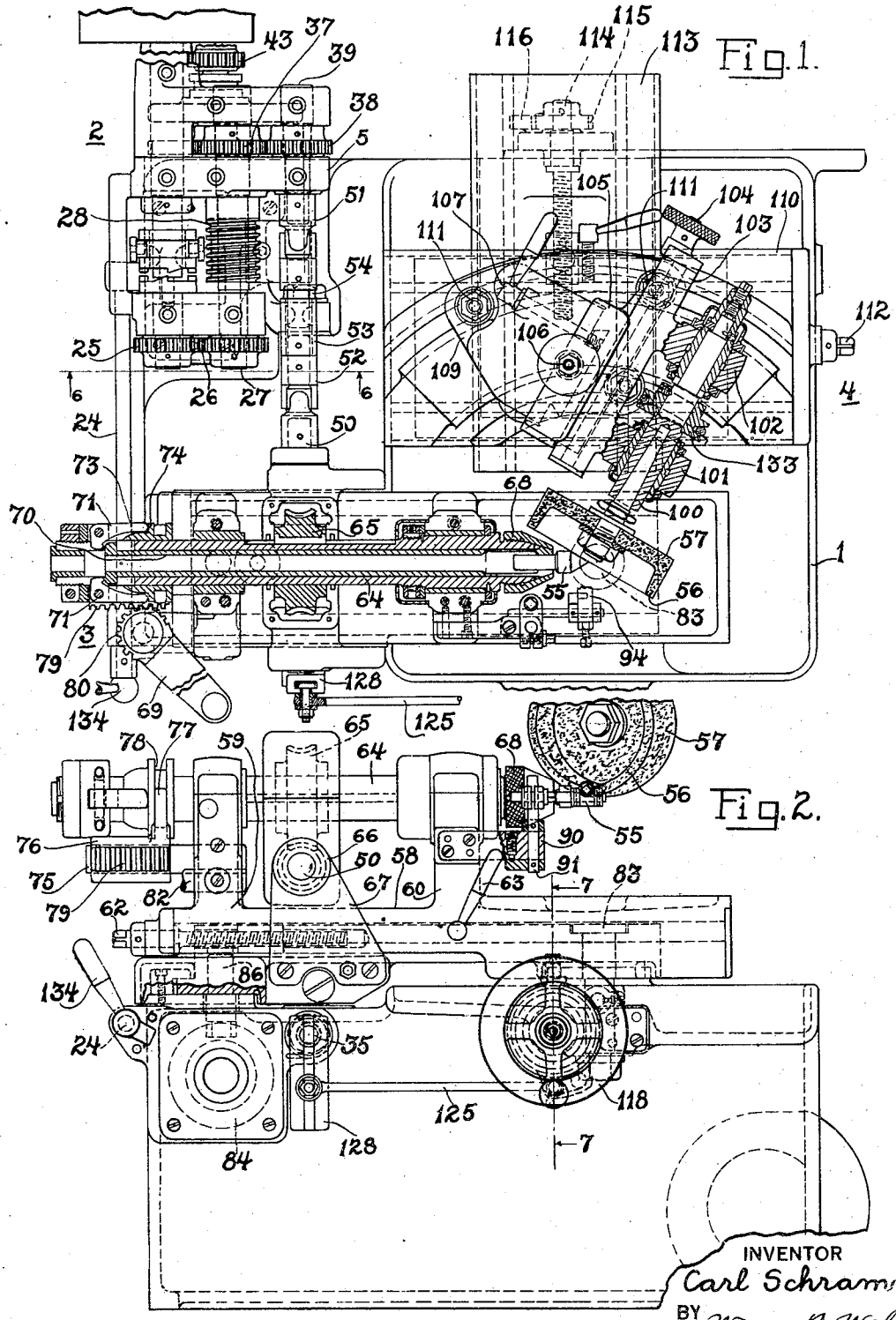


Fig. 1.

Fig. 2.

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Fig. 3.

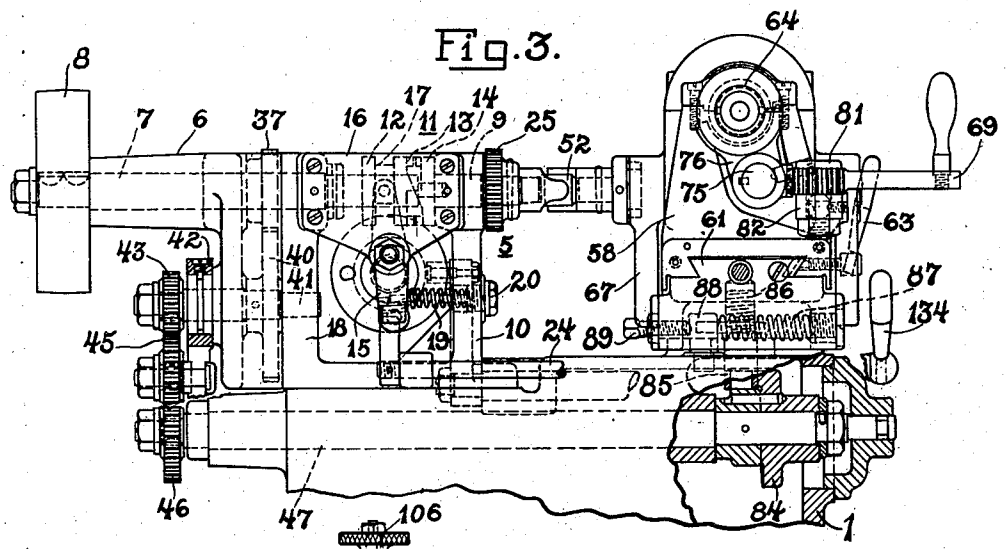


Fig. 4.

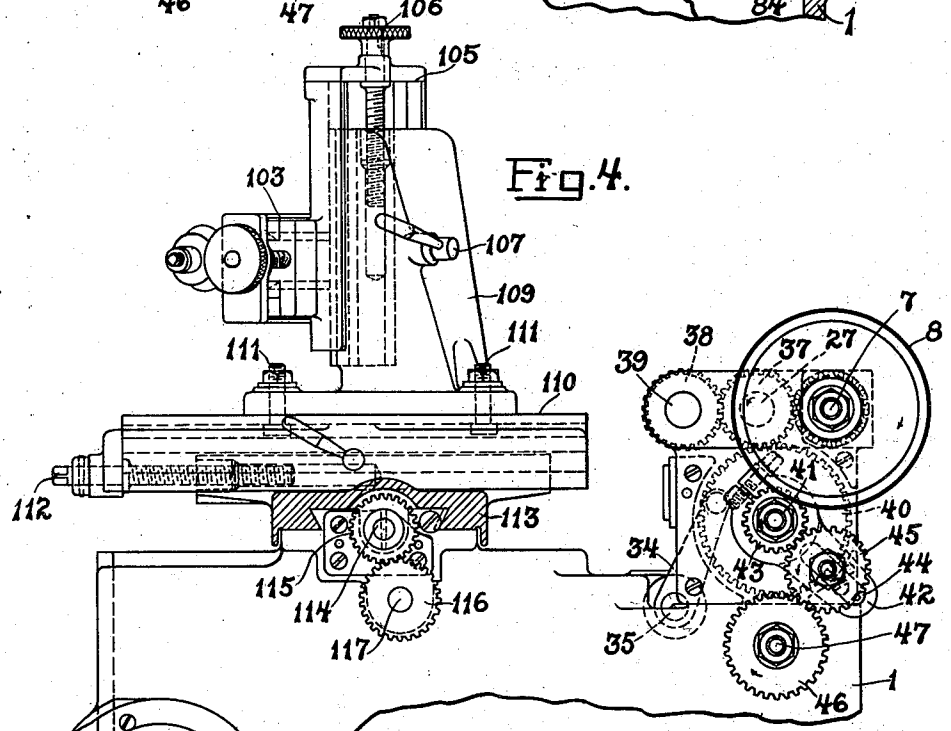
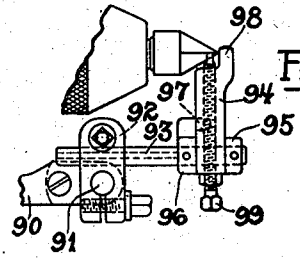


Fig. 5.



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Fig. 6.

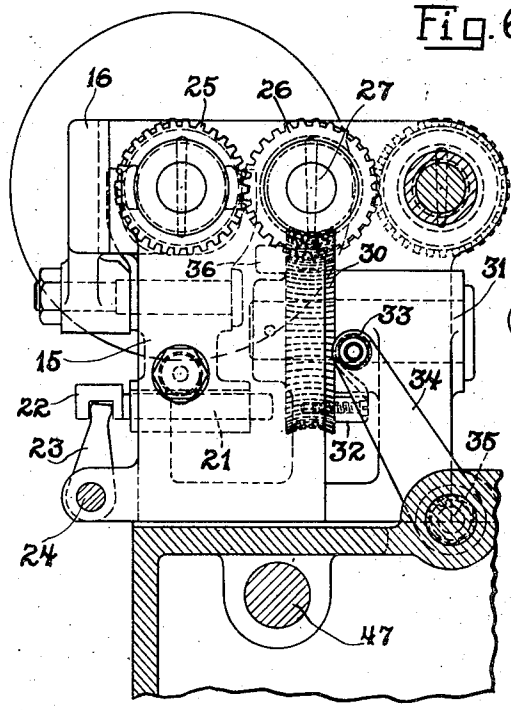
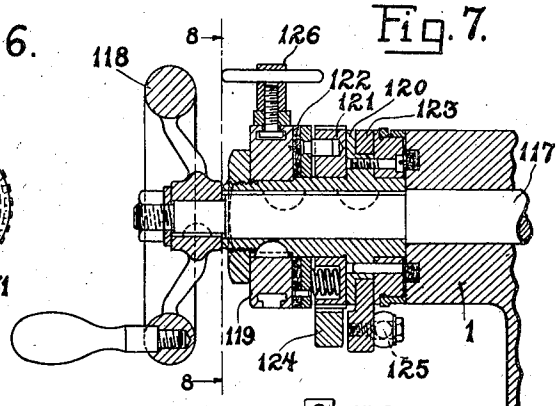


Fig. 7.



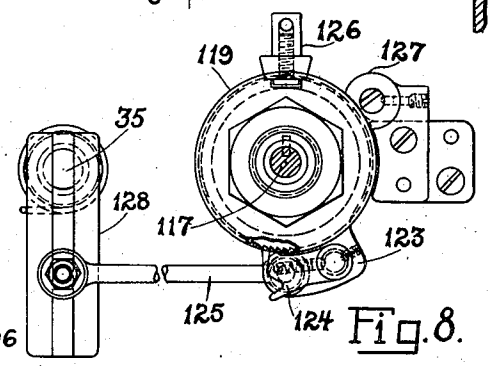
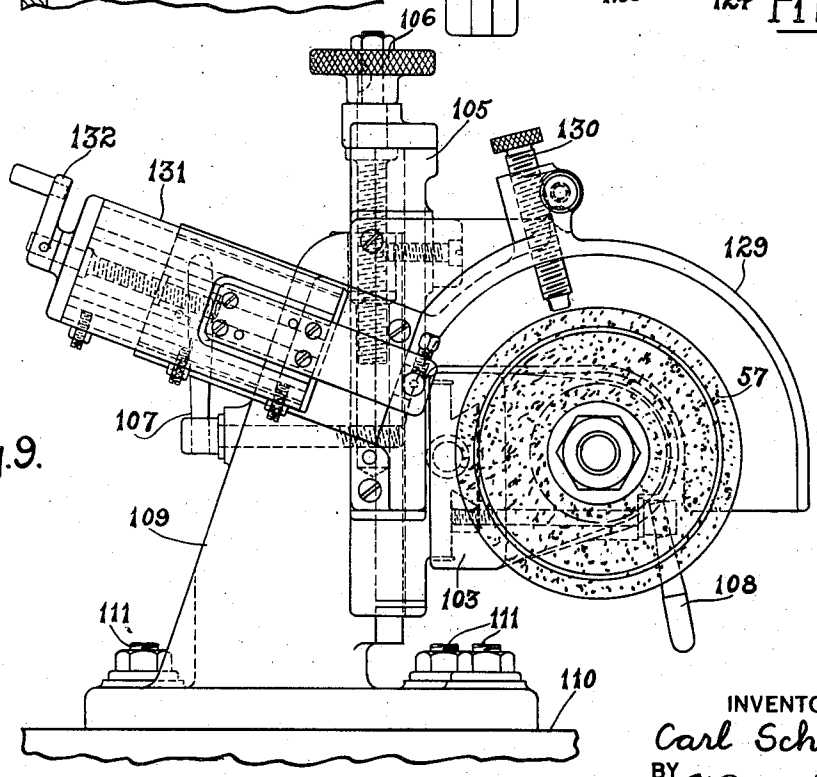


Fig. 8.

Fig. 9.



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Patented Feb. 8, 1927. 1,617,167

UNITED STATES PATENT OFFICE.

CARL SCHRAMM, OF WEST HARTFORD, CONNECTICUT, ASSIGNOR TO PRATT & WHITNEY COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW JERSEY.

GRINDING MACHINE.

Application filed May 25, 1922. Serial No. 563,591.

My invention relates to grinding machines and particularly to machines for grinding the teeth of center reamers.

One object of my invention is to provide a grinding machine that shall relieve and grind the teeth of center reamers in an efficient manner by the radial face of a grinding wheel.

Another object of my invention is to provide a grinding machine having a radial face grinding wheel engaging the teeth of a center reamer that shall be provided with means for effecting feeding movements of the grinding wheel and relieving movements by the reamer.

Another object of my invention is to provide a grinding machine of the above indicated character that shall have the teeth of the reamer engage the radial face of the grinding wheel near the peripheral face with the point of the reamer on the peripheral face of the grinding surface, and that shall relieve the reamer teeth in timed relation to the rotation thereof while effecting feeding movements by the grinding wheel.

Another object of my invention is to provide a grinding machine of the above indicated character that shall oscillate the reamer about a center beyond the end thereof while effecting feeding movements of the grinding wheel and that shall not only be provided with means for stopping the reamer in a predetermined rotative position but also shall insure the insertion of a new reamer in a predetermined rotative position.

A further object of my invention is to provide a center-reamer grinding machine that shall have the grinding wheel so mounted on slides as to effect feeding movements perpendicularly to the axis of the reamer, to effect adjustment parallelly of the reamer axis and also to effect a rotary adjustment. Moreover, the machine shall be provided with means for adjusting the reamer towards the grinding wheel, auxiliary means for vertically and horizontally adjusting the grinding wheel, means for oscillating the reamer to effect relieving movements while effecting feeding movements by the grinding wheel, and means for insuring the stopping of the reamer in a predetermined rotative position.

At the present time, it is customary to grind the teeth of center reamers by means of the so-called pencil grinding wheels. Such pencil grinding wheels, as is well known, are difficult to maintain in good condition and wear out very rapidly. Heretofore, it has been deemed impracticable to grind center-reamer teeth by either the radial or the peripheral grinding face of a grinding wheel by reason not only of the number of teeth on the reamer but also by reason of the long extended point on such a tool.

It is possible to grind the ends of twist drills on the radial face of a grinding wheel inasmuch as such tools have only two flutes and the ends of the tool are not sharp pointed and extended as in the case of center reamers. In grinding twist drills on the radial face of a grinding wheel, the axis of the tool makes a relatively large angle with the radial face of the grinding wheel and no trouble is experienced in relieving the teeth formed by the two flutes on the drill. However, in the case of center reamers, the point of the tool is somewhat extended and by reason of such shape and the large number of teeth, it is impracticable to grind and relieve the teeth in the manner now employed in grinding and relieving the ends of twist drills. The teeth of a center reamer are so close together as to prevent the relieving of one tooth without interfering with the next succeeding tooth.

In a machine constructed in accordance with my invention, a reamer is mounted on a slide with one end thereof in engagement with the radial face of a grinding wheel. The reamer engages the grinding face near the peripheral edge thereof and the extreme point of the reamer is located on the peripheral edge of the radial grinding face. By so positioning the reamer with respect to the grinding face, it is possible to relieve the teeth without any interference. The grinding wheel is provided with vertical and horizontal adjusting slides which also carry means for dressing the radial and peripheral face of the wheel. The vertical and horizontal adjusting slides are mounted on a feeding slide which is movable in a direction perpendicular to the axis of the tool. The feeding slide is mounted with a slide for adjusting the wheel parallelly to the axis of the reamer. Means is also provided for effecting a rotary adjustment of the grinding wheel,

A clutch is provided for connecting the reamer to a source of power. Such source of power also serves to oscillate the reamer for effecting relieving movements and to effect feeding movements by the grinding wheel. The reamer is oscillated about a center just beyond the end thereof in order to relieve the teeth of the reamer to the point thereof. A cam wheel, which is controlled by the clutch, carries a cam member which serves to effect feeding movements of the grinding wheel in timed relation to the rotation of the reamer. A pin, which projects from the side of the said cam wheel, serves to stop the reamer in a predetermined rotative position. The machine is also provided with means for insuring the mounting of a center reamer in a predetermined rotative position.

In the accompanying drawings:

Figure 1 is a plan view of the machine embodying my invention.

Fig. 2 is a front elevational view of the machine shown in Fig. 1.

Fig. 3 is a side elevational view of the machine shown in Fig. 1.

Fig. 4 is a rear elevational view of the machine.

Fig. 5 is a detail of the reamer setting mechanism.

Fig. 6 is a section taken along the line 6—6 of Fig. 1.

Fig. 7 is a section taken along the line 7—7 of Fig. 2.

Fig. 8 is a section taken on the line 8—8 of Fig. 7.

Fig. 9 is an end view of the grinding wheel and dressing attachments.

Referring to the drawings, a grinding machine is shown having a main frame 1 for supporting a main driving head 2, a spindle head 3, and a grinding wheel head 4. The main driving head 2 comprises a bracket 5, which is secured to the main frame 1 in any suitable manner, and a pulley bracket 6 which is fastened to the main bracket 5. A shaft 7, which is carried by the brackets 5 and 6, has a pulley 8 mounted thereon. One end of the shaft 7 abuts a short shaft 9 which is mounted on an arm 10 of the bracket 5. A clutch 11 is provided for connecting the two shafts 7 and 9 together to transmit power from the pulley 8 to the machine. The clutch 11 comprises a clutch member 12, which is keyed to, but slidably mounted on, the shaft 7. Teeth 13, which are formed on the side of the clutch member 12, engage similar teeth formed on a clutch member 14. The clutch member 14 is fixedly connected to the shaft 9. A yoke member 15, which is pivotally mounted on a plate 16, is provided with a bifurcated end portion which is fitted to a groove 17 formed on the clutch member 12. The plate 16 is secured to the two arms 10 and 18 of the bracket 5 in any suitable manner. A spring member 19 is provided for exerting a force on the yoke member normally tending to engage the teeth on the two clutch members. One end of such spring member abuts one end of the yoke member 15 and the other end thereof engages an adjustable bolt 20, which is secured to the arm 10 of the bracket 5, as shown in Fig. 3 of the drawings. The yoke member 15 carries a rod 21 near the end thereof for a purpose to be hereinafter set forth. One end 22 of the rod 21 is provided with a notched portion which is engaged by a lever 23. The lever 23 is mounted on a rod 24.

The shaft 9, which is adapted to be connected to the source of power by means of the clutch 11, carries a gear wheel 25. The gear wheel 25 meshes with a gear wheel 26 which is mounted on a shaft 27. The shaft 27 is provided with bearings on the brackets 5 and 6 and carries a worm member 28. The worm member 28 is mounted on the shaft between the arms 10 and 18 of the bracket 5 and meshes with a worm wheel 30. The worm wheel 30 is mounted on a bolt 31. The bolt 31 is secured to the bracket 5, as shown in Fig. 6 of the drawings.

A cam member 32, which is secured to one side of the worm wheel 30, serves to control the feeding movements of the machine. The cam member 32 engages a roller 33 which is mounted on a lever 34. The lever 34 is connected to a shaft 35 and controls the feeding movements of the machine in a manner to be hereinafter set forth.

A pin 36, which projects from the side of the worm wheel 30 opposite to the cam member 32, serves to operate the clutch 11 to disconnect the shaft 9 from the shaft 7 under certain conditions. When the lever 23 is moved towards the right, as shown in Fig. 6 of the drawings, the rod 21 is moved to a position in the path of movement of the pin 36. Consequently, when the pin 36 engages the rod 21, the yoke member 15 is moved against the action of the spring 19 to open the clutch 11. The purpose and operation of such means for opening the clutch will be described more fully hereinafter.

A gear wheel 37 is mounted on the shaft 27 between the arm 18 of the bracket 5 and the bracket 6. The gear wheel 37 meshes with a gear wheel 38, which is mounted on a shaft 39, and with a gear wheel 40 which is mounted on a short shaft 41. The shaft 41 is provided with bearings on the arm 18 of the bracket 5 and the bracket 6 and carries an adjustable change-gear lever 42. The lever 42 carries a gear wheel 43. The lever 42 is provided with a slot 44 within which is slidably mounted a bolt for supporting a gear wheel 45. The gear wheel 45 not only meshes with the gear wheel 43

but also with a gear wheel 46 which is fixedly mounted on a shaft 47. The shaft 47 extends through the main frame 1 of the machine and controls the relieving movements of the tool, in a manner to be hereinafter set forth.

The shaft 39, which carries the gear wheel 38, is provided with bearings in the brackets 5 and 6. The shaft 39 is connected to a shaft 50 in the spindle head 3 by means of a universal connection. The universal connection comprises two universal joints 51 and 52, a collar 53, and a short shaft 54. Such universal connections are old and well known in the art and a detailed description thereof is deemed unnecessary. The universal connection supplies power for rotating the tool.

The main spindle head 3 carries a tool 55 which is to be ground upon its cutting surfaces, this being usually a center reamer. The reamer 55 engages the radial face 56 of a grinding wheel 57. The spindle head comprises a bracket 58 having arms 59 and 60. The base of the bracket 58 is fitted to a guideway 61 that is secured in any suitable manner to the main frame 1. A screw 62 is provided for effecting adjustment of the spindle bracket 58 along the guideway 61. A screw 63 is provided for locking the spindle bracket in any set position.

A main spindle 64, which carries the tool 55 to be ground, is provided with bearings on the arms 59 and 60 of the spindle bracket 58. A worm wheel 65, which is mounted on the spindle 64, meshes with a worm member 66. The worm member 66 is mounted on the shaft 50. The shaft 50 is provided with bearings in a worm wheel housing 67 and supplies power for rotating the spindle 64.

The tool 55 is engaged by a collet chuck 68 which is controlled by a lever 69. The collet chuck is operated by a sleeve 70 which extends into the spindle 64. Two levers 71, which are pivotally mounted on the spindle 64, are provided with extended end portions which are operated to effect axial movement of the sleeve 70 to open and close the collet chuck. The opposite ends of the levers 71 are operated by cam surfaces 73 which are formed on a sleeve member 74. The axial movement of the sleeve member 74 serves to operate the levers 71 to open and close the collet chuck.

A bolt 75, which projects from one side of the arm 59 of the spindle bracket, carries a shifter bracket 76. The shifter bracket 76 is provided with a bifurcated end portion 77 which is fitted to a groove 78 on the sleeve 74. The bracket 76 is shiftably mounted on the bolt 75 and is provided with rack teeth 79 which mesh with gear teeth 80. The gear teeth 80 are formed on the end of the lever 69. The lever 69 is pivotally supported on a bolt 81, which in turn is supported on an arm 82. The arm 82 projects from the bracket 58. From the above description it is apparent the operation of the lever 69 serves to open and close the collet chuck 68 for permitting the removing and the replacing of center reamers therein.

The support for the spindle bracket 58 is pivoted on a bolt 83 which is secured to the main frame 1 of the machine. The spindle head is oscillated about the bolt 83 as a center in order to relieve the teeth on the center reamers. The oscillation of the spindle head is effected by means of a cam member 84 which is mounted on the shaft 47, as shown in Fig. 3 of the drawings. The cam member 84 engages a roller 85 on a bolt 86. The bolt 86 is connected to the support for the bracket 58. A spring member 87 is provided for normally forcing the spindle bracket 58 towards the right, as shown in Fig. 3 of the drawings. One end of the spring 87 abuts the support for the spindle bracket and the other end of the spring abuts a lug 88 which projects from the main frame 1 of the machine. A set screw 89, which is adapted to engage the lug 88, serves to limit the movement of the spindle bracket towards the right, as shown in Fig. 3 of the drawings.

It is desirable not only to stop the movement of the main spindle with the reamer in a predetermined rotative position, but also to insert a new reamer in position with the teeth thereof in a predetermined rotative position. A bracket 90 having a rod 91 rotatably mounted in the end thereof is secured to the arm 60 of the main spindle bracket in any suitable manner. The rod 91, which is rotatably mounted in the bracket 90, carries an adjustable clamp 92. The clamp 92 in turn carries a second rod 93. An arm 94 is rotatably mounted on the rod 93 between a collar 95 and a stop member 96. The arm 94 is adapted to rest on a lug 97 projecting from the stop member 96, as shown in Fig. 5 of the drawings. The arm 94 is provided with an end portion 98 which is adapted to be engaged by the end of the reamer being inserted in the collet chuck. A screw 99 projects through the arm 94 for engaging one of the reamer teeth to limit the rotative position of the reamer. It is apparent that by means of the arm 94, reamers are inserted in the chuck in a predetermined rotative position.

The grinding wheel 57 is supported on a spindle 100 which is provided with bearings on the arms 101 and 102. The arms 101 and 102 project from a horizontal slide 103. The horizontal slide 103 is controlled by a screw 104 in a well known manner and is mounted on a vertical slide 105. The vertical slide 105 is controlled by a screw

106. The vertical slide is locked in any set position by a screw 107 and the horizontal slide is locked in any set position by a screw 108. The vertical slide 105 is mounted on a bracket 109.

The bracket 109 is mounted on a slide 110 which serves to effect movement of the grinding wheel 57 parallel to the axis of the main spindle. The bracket 109 is secured to the slide 110 by means of T-headed bolts 111 which engage T-slots in the slide. By means of such bolt and slot connections a rotative or angular adjustment of the grinding wheel relative to the tool being ground may be easily effected. A screw 112 is provided for effecting movement of the slide 110.

The slide 110 is mounted on a feeding slide 113. The feeding slide 113 is directly mounted on the main frame 1 of the machine and is automatically operated in timed relation to the operation of the main spindle. A screw 114, which effects movement of the feed slide, carries a gear wheel 115 which meshes with a gear wheel 116 on a shaft 117. The shaft 117 projects through the main frame 1 of the machine and may be operated manually by a hand wheel 118, as shown in Fig. 7 of the drawings, or may be operated automatically in timed relation to the rotation of the main spindle.

A collar member 119 is fixedly mounted on a sleeve member 120. The sleeve member is fixedly mounted on the shaft 117. A ratchet wheel 121, which is rotatably mounted on the sleeve 120, is connected to the collar member 119 by means of a suitable friction clutch 122. A plate 123, which carries a pawl 124, is rotatably mounted on the sleeve 120. The plate 123 is operated by a rod 125 for effecting movement of the ratchet wheel 121 and accordingly for effecting movement of the shaft 117 to feed the grinding wheel towards the reamer. An adjustable member 126, which is mounted on the collar member 119, is adapted to engage a stop member 127 to limit the feeding movement. The rod 125, which operates the plate 123, is connected to a lever 128. The lever 128 is mounted on the shaft 35 which is operated by the lever 34. The rod 125 is connected to the lever 128 by a bolt and slot connection in order to adjust the feeding movement of the grinding wheel which is effected in accordance with the rotation of the main spindle.

Referring to Fig. 9 of the drawings, it will be noted the vertical slide 105 carries a guard 129. Such guard 129 also serves to carry means for dressing the peripheral and the radial face of the grinding wheel. As shown in the drawings, the dressing attachment for the peripheral face of the grinding wheel comprises a diamond which is mounted on a screw 130. The dressing attachment 131 for dressing the radial face of the grinding wheel is controlled by a lever 132. A detailed description of such dressing attachment is deemed unnecessary inasmuch as the construction and operation of the same is well known. A pulley 133, which is mounted on the grinding wheel spindle 100 between the arms 101 and 102, is connected to any suitable source of power for effecting independent rotation of the grinding wheel.

The rod 24, which controls the rod 21 by means of lever 23 for stopping the spindle rotation in any set position, projects through to the front of the machine. Such rod 24 is operated by means of a hand lever 134. In grinding a center reamer by the machine, a reamer is first inserted in the collet chuck by operating the lever 69 and then the rotative position of the center reamer is adjusted in accordance with the position of the arm 94. The reamer is set near the peripheral edge of the radial grinding face of the wheel with the point thereof upon such peripheral edge. Care should be taken to insure that the point of the center reamer is behind the center of the bolt 83 about which the main spindle head is adapted to oscillate. By so positioning the center reamer, it is possible to relieve the teeth to the point therof. The relative position of the reamer and the slide may be adjusted by means of the grinding wheel slides and also by means of the slide which supports the center reamer. A feeding movement of the grinding wheel may be effected for each revolution of the center reamer or for any set number of revolutions. Inasmuch as the feeding movements are effected by the same source of power as effects rotation of the center reamer, it is apparent the feeding movements are effected in timed relation to the reamer rotation.

When it is desired to stop the rotation of the main spindle and insert a new reamer in position, the hand lever 134 is so operated as to move the rod 21 into the path of movement of the pin 36 on the worm wheel 30. Upon engagement between the pin 36 and the rod 31, the yoke member 15 is operated to open the clutch 11 and separate the shafts 7 and 9. Accordingly, the rotation of the center reamer is stopped with the reamer in a predetermined rotative position. It will be noted that the clutch 11 not only controls the rotation of the center reamer but also the relieving movements and the feeding movements.

Modifications in the machine and in the arrangement and location of parts may be made within the spirit and scope of my invention and such modifications are intended to be covered by the appended claims.

What I claim is:

1. In a grinding machine, the combination with a rotating grinding wheel, and

means for mounting a pointed tool in engagement with a radial face of the grinding wheel, said tool being located with the pointed end thereof on the peripheral edge of the grinding face and extending tangentially thereof, of means for effecting relieving movements by the tool and means for effecting feeding movements by said wheel.

2. In a grinding machine, the combination with a rotating grinding wheel, and means for mounting the tool to be ground with the end thereof in engagement with the peripheral edge of a radial grinding face and extending tangentially thereof, of means for oscillating said tool about a point beyond the end thereof to effect relieving movements.

3. In a grinding machine, the combination with a grinding wheel having a radial grinding face, and means for positioning a center reamer in engagement with the grinding face of said wheel, said reamer being positioned near the periphery of the grinding surface and extending tangentially thereof, the point of the reamer being at the peripheral edge of the grinding surface, of means for rotating the reamer and said wheel, means for oscillating the reamer to relieve the teeth thereon, and means for feeding the grinding wheel in timed relation to the reamer rotation.

4. In a grinding machine, the combination with a rotating grinding wheel, means for mounting a pointed tool, having a plurality of teeth, in engagement with a radial face of said wheel, the pointed end of said tool being located on the peripheral edge of the grinding surface, said tool extending tangentially of said wheel, and means for rotating the tool, of means for oscillating the tool about a point beyond the end thereof to relieve the teeth, and means for feeding the grinding wheel in timed relation to the rotation of the tool.

5. In a grinding machine, the combination with a grinding wheel having a radial grinding face, means for positioning a center reamer in engagement with the grinding face of said wheel, said reamer being positioned near the periphery of the grinding surface with the point of the reamer at the peripheral edge of the grinding surface and extending tangentially of the wheel, and means for rotating the reamer and said wheel, of means for oscillating the reamer in timed relation to the rotation thereof and about a center beyond the end thereof to relieve the teeth, and means for effecting feeding movements between the grinding wheel and the reamer in timed relation to the reamer rotation.

6. In a grinding machine, the combination with a rotating grinding wheel, a slide for supporting a tool in engagement with a radial face of the grinding wheel, the end of said tool being located approximately on the peripheral edge of said grinding face, means for rotating the tool in engagement with the grinding wheel, and means comprising a cam member operated by the tool rotating means for oscillating said slide to relieve the teeth of the tool, of means operated by the tool rotating means for feeding the grinding wheel towards the tool in timed relation to the blank rotation.

7. In a grinding machine, the combination with a rotating grinding wheel, a slide for supporting a pointed tool in engagement with a radial face of the grinding wheel, two slides for supporting the grinding wheel and adapted to adjust the grinding wheel perpendicularly and parallelly to the axis of the tool, means for effecting rotary adjustment of the wheel with respect to the tool, means for rotating the tool in engagement with the grinding wheel, and means comprising a cam member for oscillating the tool slide in timed relation to the rotation of said tool, of means for effecting feeding movements of the grinding wheel in a direction perpendicular to the tool axis and in timed relation to the blank rotation.

8. In a grinding machine, the combination with a rotating grinding wheel, means comprising a slide for supporting a pointed tool in engagement with a radial face of said grinding wheel, said slide serving to adjust the tool with respect to the wheel, and means for rotating the tool, of a cam member operated by said tool rotating means and serving to oscillate the tool in timed relation to the tool rotation, means for insuring the stopping of the tool rotation with the tool in a predetermined rotative position, and means for feeding the wheel in timed relation to the tool rotation.

9. In a grinding machine, the combination with a rotating grinding wheel, a slide for supporting a pointed tool in engagement with a radial face of the grinding wheel, the pointed end of said tool being located on the peripheral edge of said grinding face, means for rotating the tool in engagement with the grinding wheel, and means comprising a cam member for oscillating said tool slide in timed relation to the rotation of said tool, of means for feeding the grinding wheel in a direction perpendicular to the tool axis and in timed relation to the tool rotation, and automatic means for stopping the rotation of the tool in a predetermined position.

10. In a grinding machine, the combination with a rotating grinding wheel, means for supporting a pointed tool in engagement with a radial face of the grinding wheel, and means for rotating the tool, of a gear wheel operated by said tool rotating means,

means comprising a cam member carried by said gear wheel for effecting feeding movements between the grinding wheel and the tool, and means comprising a pin projecting from said gear wheel for insuring the stopping of the tool rotations with the tool in a predetermined rotative position.

11. In a grinding machine, the combination with a rotating grinding wheel, a slide for supporting a pointed tool in engagement with a radial face of said grinding wheel, and means for rotating said tool, of a gear wheel operated by said tool rotating means, means comprising a cam member on said gear wheel for effecting feeding movements of said grinding wheel in timed relation to the tool rotation, and a pin mounted on said gear wheel for insuring the stopping of the tool rotation with the tool in a predetermined rotative position.

12. In a grinding machine, the combination with a rotating grinding wheel, means for supporting a pointed tool in engagement with a radial face of the grinding wheel, means comprising a clutch for connecting a source of power to the tool to effect rotation thereof, and a gear wheel operated by said tool rotating means, of means comprising a cam member carried by said gear wheel for effecting feeding movements between the tool and the grinding wheel in timed relation to the tool rotation, and means comprising a pin projecting from said gear wheel for opening said clutch under certain conditions to insure the stopping of the tool rotation with the tool in a predetermined rotative position.

13. In a grinding machine, the combination with a rotating grinding wheel, means for mounting a pointed tool to engage a radial face of the grinding wheel near the peripheral edge thereof, means comprising a clutch and a gear wheel for connecting a source of power to effect rotation of the tool, and means operated by the source of power for oscillating the tool to relieve the teeth thereon, of means comprising a pin projecting from said gear wheel for opening said clutch under certain conditions to insure the stopping of the tool rotation with the tool in a predetermined rotative position.

14. In a grinding machine, the combination with a rotating grinding wheel, means for mounting a pointed tool to engage a radial face of the grinding wheel near the peripheral edge thereof, means comprising a clutch for connecting a source of power to the tool to effect rotation thereof, and means operated by said source of power for oscillating the tool to relieve the teeth thereon, of a gear wheel connected to said clutch, means comprising a cam member mounted on said gear wheel for effecting feeding movements by the grinding wheel, and means comprising a pin projecting from said gear wheel for opening said clutch under certain conditions to insure the stopping of the tool rotation with the tool in a predetermined rotative position.

15. In a grinding machine, the combination comprising a rotating grinding wheel, means for mounting a pointed tool in engagement with a radial face of the grinding wheel, said tool being located with the pointed end thereof on the peripheral edge of the grinding face, and means for insuring the mounting of the tool in the machine in a predetermined rotative position.

16. In a grinding machine, the combination with a rotating grinding wheel, and means for mounting a pointed tool in engagement with a radial face of the grinding wheel, said tool being located near the peripheral edge of the grinding surface, of means for rotating the tool, means for insuring the stopping of the tool rotation with the tool in a predetermined rotative position, and means for insuring the insertion of a new tool in the machine in a predetermined rotative position.

17. In a grinding machine, the combination with a rotating grinding wheel, means comprising a slide for mounting a pointed tool having a plurality of teeth in engagement with a radial face of the grinding wheel, said tool being located near the peripheral edge of the grinding surface, of means for rotating the tool, means for insuring the stopping of the tool rotation with the tool in a predetermined rotative position, and means mounted on the tool slide for insuring the insertion of a new tool in the machine in a predetermined rotative position.

18. In a grinding machine, the combination with a rotating grinding wheel, means for mounting a pointed tool in engagement with a radial face of the grinding wheel, a slide movable perpendicularly of the axis of the tool for supporting the grinding wheel, a slide movable parallelly to the axis of the tool for supporting the first grinding wheel slide, and means for rotating the tool, of means for effecting relieving movements of the tool and feeding movements of the grinding wheel in timed relation to the rotative movement of the tool.

19. In a grinding machine, the combination with a rotating grinding wheel, means comprising a slide for mounting a pointed tool in engagement with a radial face of the grinding wheel, a slide for so supporting the grinding wheel as to effect adjustments of the grinding wheel perpendicularly of the axis of the tool, a second slide for supporting the first grinding wheel slide and adapted to effect adjustments of the grinding wheel parallelly to the axis of the tool, and means on the first grinding wheel slide for effecting rotary adjustment of the grinding wheel, of means for rotating the tool, means for oscil-

lating the tool in timed relation to the rotation thereof, and means for effecting feeding movements on the second grinding wheel slide in timed relation to the tool rotation.

20. In a grinding machine, the combination with a rotating grinding wheel, means comprising a slide for mounting a pointed tool in engagement with a radial face of the grinding wheel, said tool being located with the pointed end thereof on the peripheral edge of said grinding face, means comprising a clutch member for connecting the tool to a source of power, and a gear wheel operated from said source of power through the clutch, of means comprising a cam mounted on said gear wheel for effecting feeding movements of the grinding wheel, means comprising a cam member operated from said source of power for effecting oscillatory movements of the tool to relieve the teeth thereon, and means comprising a pin projecting from said gear wheel to stop a rotative movement of the tool in a predetermined rotative position under certain conditions.

21. In a grinding machine, the combination with a rotating grinding wheel, means for mounting a pointed tool in engagement with a radial face of the grinding wheel, a feeding slide for supporting the grinding wheel and movable perpendicularly to the tool axis, a slide for supporting the feeding slide and movable parallelly to the tool axis, a vertical and a horizontal movable slide mounted on the feeding slide for directly supporting the grinding wheel, and means mounted on the feeding slide for dressing the radial and peripheral faces of the grinding wheel, of means for rotating the tool, and means for effecting relieving movements of the tool and feeding movements of the grinding wheel in timed relation to the tool rotation.

In testimony whereof, I hereto affix my signature.

CARL SCHRAMM.