Nov. 23, 1926. 1,608,367

E. BUCKINGHAM

DEVICE FOR GENERATING GLOBOIDAL WORMS

Filed June 23, 1924 2 Sheets-Sheet 1

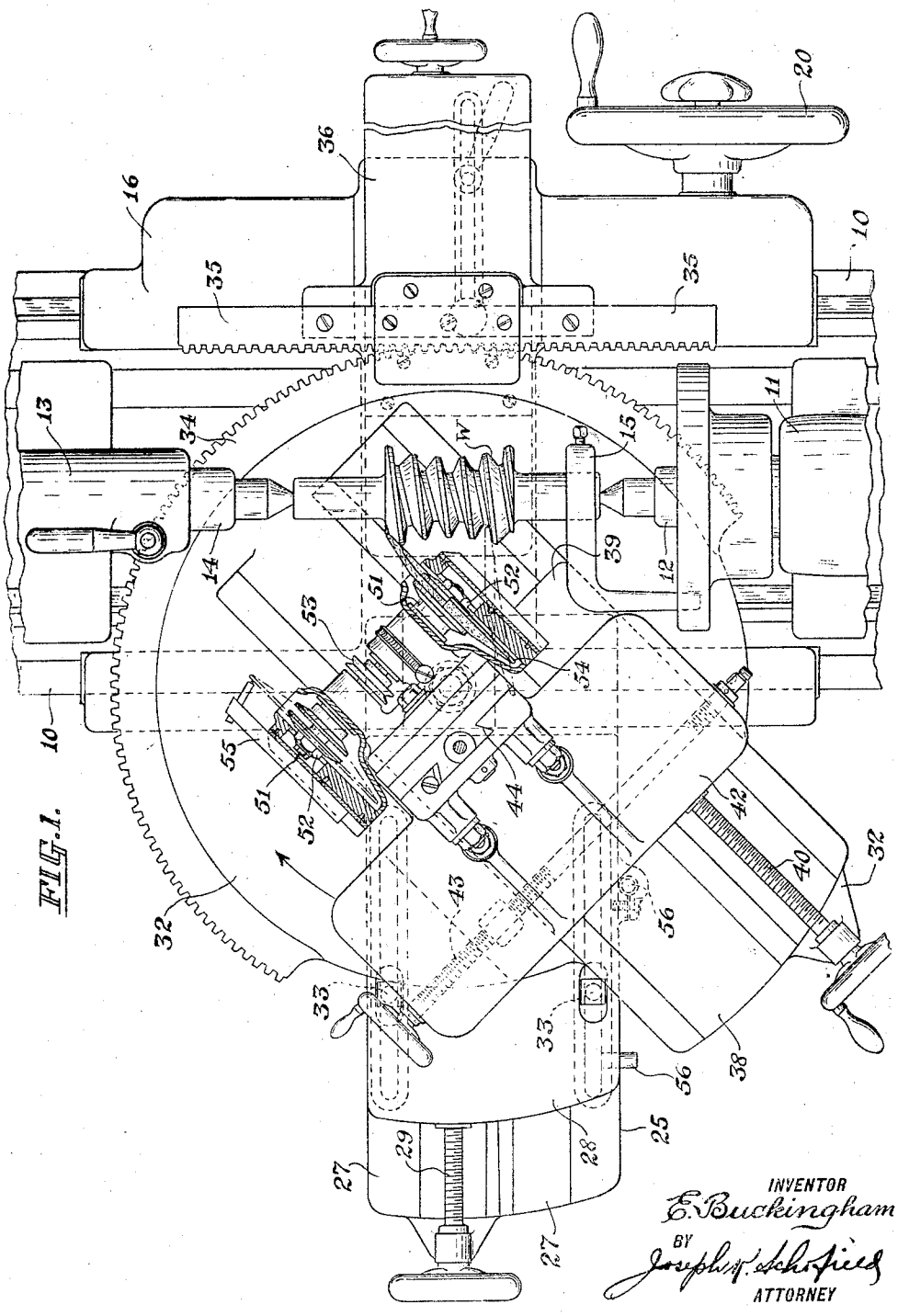

FIG. 1.

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2 Sheets-Sheet 2

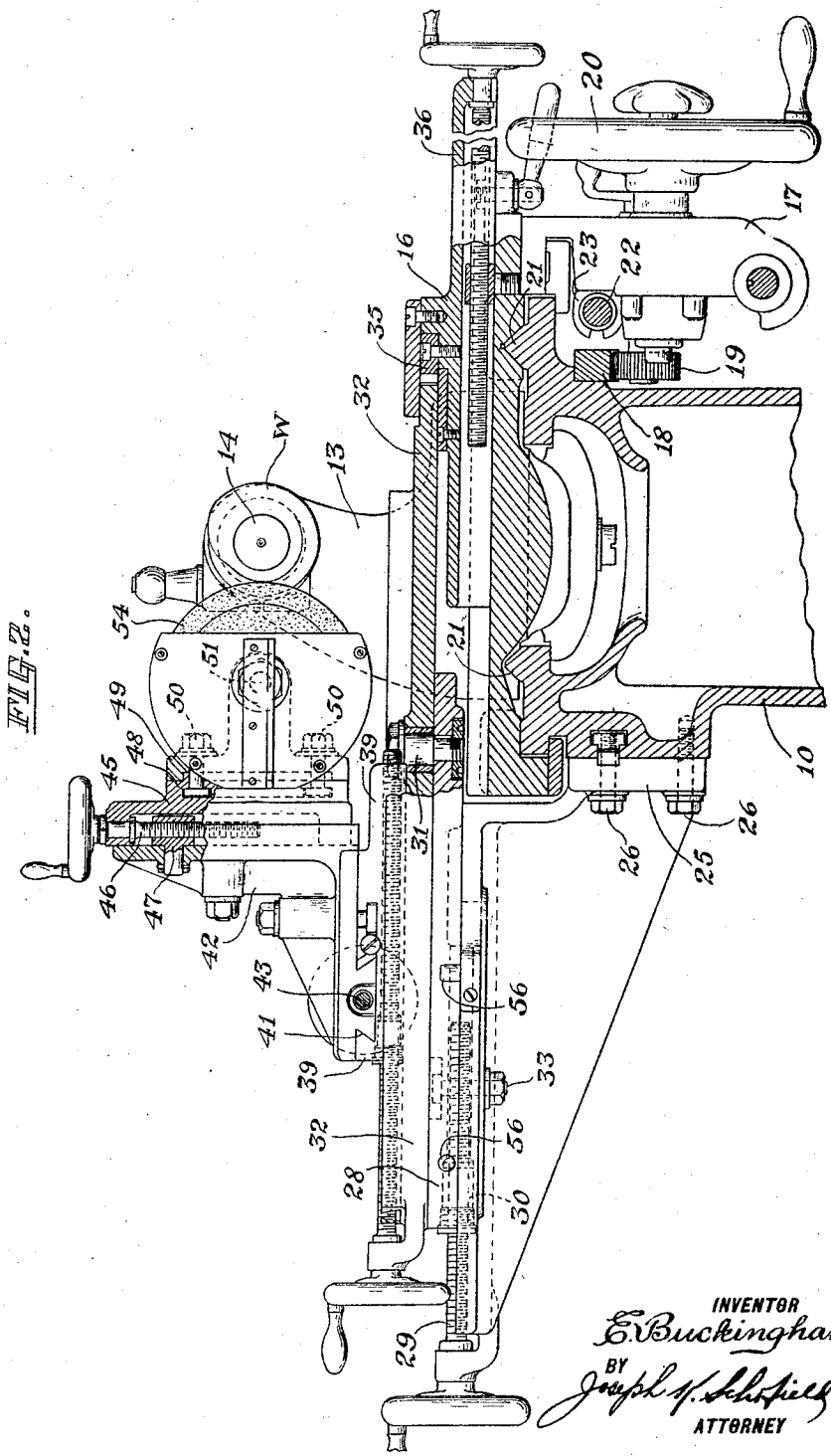

FIG. 2.

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UNITED STATES PATENT OFFICE.

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DEVICE FOR GENERATING GLOBOIDAL WORMS.

Application filed June 23, 1924. Serial No. 721,864.

This invention relates to a device for grinding worms and particularly to a grinding device for generating a type of worm disclosed and claimed in the patent to Wildhaber No. 1,514.491 dated November 4, 1924.

An object of the present invention is to provide a grinding device particularly adapted for generating this special form of worm and which will be applicable to a conventional form of engine lathe.

Another object of the invention is to provide a precision grinding device for the tooth flanks of a worm of novel form which will permit the novel form of worm to be generated to a high precision by means of a simple attachment mounted upon a lathe or other form of machine tool.

One feature which enables me to accomplish the above named objects is that means to rotate the worm blank are provided on the lathe, and means for oscillating an abrasive or cutting wheel about an axis adapted to be adjusted and in predetermined position relative to the worm is provided.

Another feature which is advantageous is that the oscillating movement of the abrasive or cutting wheel is obtained by the longitudinal movement of the lathe tool carriage and its attached mechanism.

Another principal object of the invention is to provide a worm generating device which will be adjustable for different diameters of worms and also for single and multiple thread worms adapted to operate in combination with worm wheels of any diameter, number and inclination of teeth.

A further object of the invention is to provide a special mounting on the oscillating means for the abrasive wheel and an adjustable wheel head which will permit the abrasive wheel to be rotatably mounted on its oscillating table, the axis of rotation being adjustable in a direction normal to the axis of oscillation of the table carrying the head.

Also, preferably, means for mounting a grinding wheel upon opposite ends of its spindle are provided so that with the wheel in one position, the flanks on one side of the worm teeth may be ground and, with the wheel mounted at the opposite end of its spindle and in opposed position, the flanks upon the opposite sides of the teeth may be ground.

With these and other objects in view, my invention consists in the features of construction and operation set forth in the following specification and illustrated in the accompanying drawings.

In the accompanying drawings annexed hereto and forming a part of this specification, I have shown my invention embodied as an attachment for an engine lathe, but it will be understood that the invention can be otherwise embodied and that the drawings are not to be construed as defining or limiting the scope of the invention, the claims appended to this specification being relied upon for that purpose.

In the drawings:

Figure 1 is a plan view of the entire device mounted upon an engine lathe, parts of the lathe being also shown, and

Fig. 2 is a transverse elevation in section, the section being taken through the pivot of the oscillating table carrying the abrasive wheel.

In the above mentioned drawings, I have shown but one embodiment of the invention which is now deemed preferable, but it is to be understood that changes and modifications may be made within the scope of the appended claims without departing from the spirit of the invention.

Briefly, and in its broadest aspect, my invention consists in the following principal parts: first, an engine lathe or other machine tool having means for rotating a work blank upon a fixed axis at varying speeds and having a slide or carriage movable longitudinally along the base of the machine, the movements of the carriage being in timed relation to the rotative movement of the work spindle; second, a bracket or support mounted upon the base and having a slide adjustably mounted thereon so that it may be adjusted transversely of the base; third, an oscillating table pivotally mounted on the adjustable slide and having thereon a head carrying a rotatable abrasive wheel; fourth, adjusting means for this head on the oscillating table and means to angularly adjust the grinding wheel about an axis normal to the axis upon which the table may oscillate; fifth, oscillating means for the table preferably in the form of a gear mounted at the periphery of the oscillating table; and sixth, a rack on the lathe carriage or slide adapted to mesh with this gear.

Referring more in detail to the figures of the drawings, I provide a lathe having a

base 10, a headstock 11 and a headstock spindle 12 which may be rotated at any desired speed by any suitable means (not shown). Also on the lathe bed or base 10 is a tailstock 13 having a tailstock spindle 14 in alignment with the headstock spindle. By means of the headstock 12 and tailstock spindles 14, a worm blank W may be rotatably mounted and driven at any desired speed through the driving dog 15 shown in Fig. 1.

Adapted to be reciprocated along the lathe bed 10 is a tool carriage 16 and apron mechanism 17 similar to those usually found on engine lathes. This carriage 16 is provided with means for moving it along the base 10 as by means of a rack 18 mounted on the bed in mesh with a pinion 19 on the carriage 16. Rotation of the hand wheel 20 through intermediate gears (not shown) is adapted to manually rotate the pinion 19 and move the slide 16 and attached parts longitudinally along the ways 21 of the lathe. Also, preferably, a lead screw 22 is provided extending parallelly with the ways 21 of the bed and adapted to be engaged by a split nut 23 secured on the carriage apron 17. It will be seen, therefore, that rotation of this screw 22 will advance the tool slide 16 and apron 17 back and forth along the lathe bed 10. As all of the above mentioned parts are those usually found on engine lathes, no further description of them is thought to be necessary. It may be said, however, that by means of driving connections between the headstock spindle 12 and the screw 22, the tool carriage 16 may be advanced along the base 10 at any predetermined speed relative to the rotative speed of the work spindle 12 and work blank W, this ratio being varied by means of change gears (not shown) forming part of the engine lathe.

Mounted upon a rear vertical surface of the lathe bed is a bracket 25 suitably secured thereto by means of clamping screws 26. This bracket 25 is provided on its upper horizontal surface with suitable ways 27 along which a slide 28 may be adjusted. In order to adjust this slide 28, a screw 29 is provided rotatably mounted in an extension of the bracket 25 and engaging a nut 30 in the slide 28. Movement of this slide 28 is in a direction exactly normal to the axis of rotation of the work as determined by the head and tailstock spindles 12 and 14 of the lathe. Mounted near the forward end of this slide 28 is a vertical pin or pivot 31 upon which is pivotally mounted an oscillatory carriage or table 32.

It will be seen from this description that the position of the pivot 31 and therefore the center of oscillation of the table 32 may be adjusted laterally toward or from the axis of rotation of the work blank W. By clamping screws or bolts 33, slide 28 may be retained firmly in position. In order to oscillate this carriage or table 32, a segmental gear 34 is formed upon a portion of its outer periphery which is adapted to mesh with a rack 35 fastened to a cross slide 36 on the tool carriage 16. It will therefore be seen that longitudinal movement of the tool carriage 16 will move the rack 35 longitudinally along the ways of the lathe and, as it is in mesh with the gear 34 on the oscillating table 32, it will cause this table or carriage 32 to be oscillated in timed relation thereto. Also as the rotation of the work W is in timed relation to the longitudinal movement of the tool carriage 16, the table 32 will be oscillated in timed relation to the rotation of the work W.

As clearly indicated in Fig. 2, the rack 35 is carried upon slide 36 which is adjustable laterally upon the tool carriage 16. By means of this slide 36, the rack 35 may be intermeshed with the gear 34 upon the oscillating table 32 after the oscillating table 32 has been adjusted to exactly its correct position for the particular worm W to be ground. For each position of the slide 36 and vertical pin 31, the slide 36 carrying the rack 35 must be correspondingly adjusted so that the rack 35 will engage and actuate the gear 34 on the oscillating table 32. This adjustment is required to be made but once for each worm of any one form and size.

Mounted upon the upper surface of the oscillating table 32 are suitable ways 38 extending diametrically across the table. On these ways 38 is a slide 39, this slide 39 being adjustable by means of a screw 40 rotatably mounted in the table and engaging a nut mounted in the slide. Mounted on this slide 39 are ways 41 extending normally to the direction of the ways 38 upon which the slide 39 moves, and on which may be mounted a suitable wheel carrying head 42. In order to adjust this head 42 along the ways 41 of the slide 39, an adjusting screw 43 is provided. The wheel head 42 upon its forward vertical surface is provided with vertically extending ways 44 in which a slide 45 may be adjusted by means of a screw 46 and nut 47. This slide 45 is provided with arcuate slots 48 by means of which a wheel support 49 may be angularly adjusted to any oblique position in which position it may be clamped by screws 50. On this support 49 is an elongated spindle 51 having wheel attaching means 52 at its opposite ends and a driving pulley 53 positioned intermediate portions of the supporting member 49.

With an abrasive wheel 54 mounted upon one end of the wheel spindle 51, it may be adjusted by means of the slides above described to contact with and abrade one side of the screw thread or projection on the worm W being ground. To abrade the op-

posite side of the flanks or projection on the worm W, the abrasive wheel 54 is mounted upon the opposite end of its spindle 51 in reversed position as indicated in dot and dash lines in Fig. 1.

The abrasive wheel or wheels 54 on a spindle contact with the worm W being ground upon a flat or plane surface normal to their axis of rotation. In order to maintain this work engaging surface of the wheel 54 precisely in its proper position and relation, a dressing device 55 may be used, that shown in Fig. 1 being a bar having a diamond offset near one end. This bar is adapted to be manually reciprocated while resting upon surfaces provided therefor on parts secured to the wheel support 49. Preferably, such supports are provided adjacent both ends of the spindle 51 so that the grinding wheel 54 may be dressed to accurately position its work engaging surface after being adjusted in position at either end of the spindle 51.

Although the operation may be clear in view of the preceding description, a short analysis of the operations will be given. The worm blank W is first mounted upon the spindles 12 and 14 of the lathe and the tool carriage 16 has its screw 22 connected by suitable gears (not shown) to the spindle 12 so that rotation of the worm blank W in opposite directions will reciprocate the tool slide 16 and parts attached thereto. For this purpose mechanism shown in patent to Ingham et al. No. 1,501,346 granted July 15, 1924 may be used. It will be understood, however, that any standard form of screw threading lathe may be employed having a carriage reciprocated by a lead screw. The oscillating table 16 is then adjusted so that its axis of oscillation determined by the position of the vertical pin 31 will be at a predetermined distance from the axis of rotation of the work blank W. To facilitate making this adjustment, calipering pins 56 are mounted at one side of the device, one being secured in the bracket 25 and the other in the slide 28 carrying the pivot 31 for the oscillating table 32. By means of a micrometer contacting with these pins, adjustments of the pivot 31 may be quickly and accurately made.

With the oscillating table 32 accurately positioned, the rack 35 is advanced by means of its adjusting slide 36 so that it will contact with the gear 34 at the periphery of the oscillating table 32. Rotation of the work W by the spindles 12 and 14 will therefore oscillate the table 32 in opposite directions in accordance with the reciprocatory movements of the tool carriage 16.

To correctly position the abrasive wheel 54 relative to the axis of oscillation of the table 32 after the table has been adjusted, the slide 39 on the table 32 is advanced to a position so that the periphery of the wheel 54 will engage the flank of the worm W being ground. This distance will vary materially with different diameters of worms. The transverse slide 42 carrying wheel 54 is adjusted so that the normal distance between the plane work engaging surface of the wheel 54 is at precisely the correct distance from the axis of oscillation of the table 32. The wheel carrying support 49 may also be swivelled to an oblique position if the particular worm being ground is to mesh with a worm wheel having obliquely formed teeth. With this adjustment made, the parts are in position for operation. This is accomplished by rotating the work blank W in one direction with the wheel 54 in advanced position and in contact with the worm W. Thus, the wheel 54 is made to contact with one flank of the projection on the worm W while in engagement therewith throughout its length. The slide 39 is then manually withdrawn slightly so that the wheel 54 is out of contact with the work W. Rotation of the work W in the opposite direction then oscillates the table 32 in a reverse direction bringing the wheel 54 back to its initial position. With the wheel 54 again in this position, the slide 39 is again advanced and the operations repeated. When this flank of the worm W has been completely ground to predetermined position, the abrasive wheel 54 is removed from one end of its spindle 51 and replaced oppositely disposed at the other end of the spindle. The work engaging surface then may be properly dressed again by means of the bar 55 and the table 32 oscillated to a position where the wheel 54 will contact with the work W. The operations are then carried out with the wheel 54 at this end of the spindle 51 in the same manner as those previously described.

It will be understood that a number of different types of worms W may be generated in this machine adapted to contact with teeth on a worm wheel having plane surfaces. The worm W may be of the multiple thread type or may be adapted to contact with teeth on a worm wheel disposed obliquely relative to its axis.

What I claim is:

1. A device for grinding worms comprising in combination, a base, means thereon for rotating a worm blank about a fixed axis, an oscillating table having an abrasive wheel rotatably mounted thereon, a carriage movable in a direction parallel to the axis of the work, and means connecting said carriage and table whereby movement of said carriage will oscillate said table in timed relation to the movement of the carriage.

2. A device for grinding worms comprising in combination, a base, means thereon for rotating a worm blank about a fixed axis, an oscillating table having an abrasive

wheel rotatably mounted thereon, a carriage movable in a direction parallel to the axis of the work, and gear means connecting said carriage and table whereby movement of said carriage will oscillate said table in timed relation to the movement of the carriage.

3. A device for grinding worms comprising in combination, a base, means thereon for rotating a worm blank about a fixed axis, an oscillating table having an abrasive wheel rotatably mounted thereon, means to axially adjust the position of said wheel on said table, a carriage movable in a direction parallel to the axis of the work, and means connecting said carriage and table whereby movement of said carriage will oscillate said table in timed relation to the movement of the carriage.

4. A device for grinding worms comprising in combination, a base, means thereon for rotating a worm blank, a support having a pivot outstanding therefrom, a table having an abrasive wheel rotatably mounted thereon and adapted to be oscillated about said pivot, means to laterally adjust the position of the support, and means to oscillate said table in timed relation to the rotation of the work.

5. A device for grinding worms comprising in combination, a base, means thereon for rotating a worm blank, a support having a pivot outstanding therefrom, a table having an abrasive wheel rotatably mounted thereon and adapted to oscillate about said pivot, means to laterally adjust the position of the support, a carriage movable in a direction parallel to the axis of the work, and means connecting said table and carriage whereby movement of said carriage will oscillate said table.

6. A device for grinding worms comprising in combination, a base, means thereon for rotating a worm blank, a support having a pivot outstanding therefrom, an oscillating table having an abrasive wheel rotatably mounted thereon, a carriage movable in a direction parallel to the axis of the work, means to move said carriage in timed relation to the rotation of the worm blank, and means connecting said table and carriage whereby movement of said carriage will oscillate said table.

7. A device for grinding worms comprising in combination, a base, means thereon for rotating a worm blank, a bracket supported on said base, an oscillating table having an abrasive wheel rotatably mounted thereon supported on said bracket, means to laterally adjust the position of the table whereby its axis of oscillation may be adjusted toward or from the axis of the worm blank, a carriage movable in a direction parallel to the axis of the work, and rack and gear means connecting said table and carriage whereby movement of said carriage will oscillate said table in timed relation thereto.

8. A device for grinding worms comprising in combination, a base, means thereon for rotating a worm blank, a bracket supported on said base, an oscillating table having an abrasive wheel rotatably mounted thereon supported on said bracket, means to laterally adjust the position of the table, a carriage movable in a direction parallel to the axis of the work, means to move said carriage in timed relation to the rotation of the worm blank, and means connecting said table and carriage whereby movement of said carriage will oscillate said table.

9. A device for grinding worms comprising in combination, a base, means thereon for rotating a worm blank, a bracket supported on said base, an oscillating table having an abrasive wheel rotatably mounted thereon supported on said bracket, means to adjust the position of the wheel on said table, a carriage movable in a direction parallel to the axis of the work, and means connecting said table and carriage whereby movement of said carriage will oscillate said table.

10. A device for generating the tooth engaging surfaces of worms comprising in combination, a base, means thereon for rotating a worm blank, an oscillating table having an abrasive wheel rotatably mounted thereon, a carriage movable in a direction parallel to the axis of the work, and means drivingly connecting the blank rotating means, the carriage and table whereby they may be moved in timed relation to each other.

11. A device for generating the tooth engaging surfaces of worms comprising in combination, a base, means thereon for rotating a worm blank, an oscillating table having an abrasive wheel rotatably mounted thereon, means to adjust the position of the wheel thereon, a carriage movable in a direction parallel to the axis of the work, and means drivingly connecting the blank rotating means, the carriage and the table whereby they may be moved in timed relation to each other.

12. A device for generating the tooth engaging surfaces of worms comprising in combination, a base, means thereon for rotating a worm blank, an oscillating table having an abrasive wheel rotatably mounted thereon, means to adjust the axis of rotation of said table toward and from the axis of rotation of the work blank, a carriage movable in a direction parallel to the axis of the work, and means drivingly connecting the blank rotating means, the carriage and table whereby they may be moved in timed relation to each other.

13. An attachment for lathes comprising in combination, a support adapted to be mounted upon the base of the lathe, a pivot ad-

justably mounted thereon, a table mounted thereon so that it is free to oscillate about said pivot, an abrasive wheel on said table, and means on said table engaging the tool carriage of the lathe whereby reciprocating the carriage will oscillate the table and wheel in timed relation to the movement of the carriage.

14. An attachment for lathes comprising in combination, a support adapted to be mounted upon the base of the lathe, a pivot adjustably mounted thereon, a table mounted thereon so that it is free to oscillate about said pivot, means to adjust the position of said pivot, an abrasive wheel on said table, and means on said table engaging the tool carriage of the lathe whereby reciprocating the carriage will oscillate the table and wheel.

15. An attachment for lathes comprising in combination, a bracket adapted to be mounted upon the base of the lathe, a cross slide adjustable on said bracket and carrying a pivot at its inner end, a table mounted so that it is free to oscillate about said pivot, an abrasive wheel on said table, means on said table engaging the tool carriage of the lathe whereby reciprocating the carriage will oscillate the table and wheel.

16. An attachment for lathes comprising in combination, a bracket adapted to be mounted upon the base of the lathe, a cross slide adjustable on said bracket and carrying a pivot at its inner end, a table mounted thereon so that it is free to oscillate about said pivot, an abrasive wheel on said table, means to adjust said wheel in all directions on said table, and means on said table engaging the tool carriage of the lathe whereby reciprocating the carriage will oscillate the table and wheel.

17. An attachment for lathes comprising in combination, a bracket adapted to be mounted upon the base of the lathe, a table mounted thereon so that it is free to oscillate about an axis normal to the axis of rotation of the work, a slide on said table adjustable toward and from the axis of rotation of the table, an abrasive wheel on said slide, and means on said table adapted to engage the tool carriage of the lathe whereby reciprocating the carriage will oscillate the table and wheel.

18. An attachment for lathes comprising in combination, a bracket adapted to be mounted upon the base of the lathe, a table mounted thereon so that it is free to oscillate about a pivot mounted on said bracket and adjustable relative thereto, a slide on said table adjustable toward and from said pivot, an abrasive wheel on said slide, said slide permitting the wheel to oscillate about said pivot with its abrasive surface at any distance therefrom, and means to adjust the position of the wheel on said table vertically and angularly.

19. An attachment for lathes comprising in combination, a support adapted to be mounted upon the base of the lathe, a table mounted thereon so that it may oscillate about a pivot mounted on said support, a slide on said table adjustable toward and from said pivot, a wheel head having an abrasive wheel thereon adjustably mounted on said slide whereby the wheel may be adjusted laterally, said slide and head permitting the wheel to oscillate about said pivot with its abrasive surface at any distance from the pivot and at any angle to the direction of movement of the slide.

20. An attachment for lathes comprising in combination, a support adapted to be mounted upon the base of the lathe, a table mounted thereon so that it may oscillate about a pivot mounted on said support, a slide on said table adjustable toward and from said pivot, a wheel head having an abrasive wheel thereon adjustably mounted on said slide whereby the wheel may be adjusted laterally, said slide and head permitting the wheel to oscillate about said pivot with its abrasive surface at any distance from the pivot and at any angle to the direction of movement of the slide, said wheel head permitting adjustment of said wheel vertically and angularly.

In testimony whereof, I hereto affix my signature.

EARLE BUCKINGHAM.