K. HOEPFNER.

GEAR GENERATING MACHINE.

APPLICATION FILED APR. 1, 1912.

1,054,846.

Patented Mar. 4, 1913.

3 SHEETS—SHEET 1.

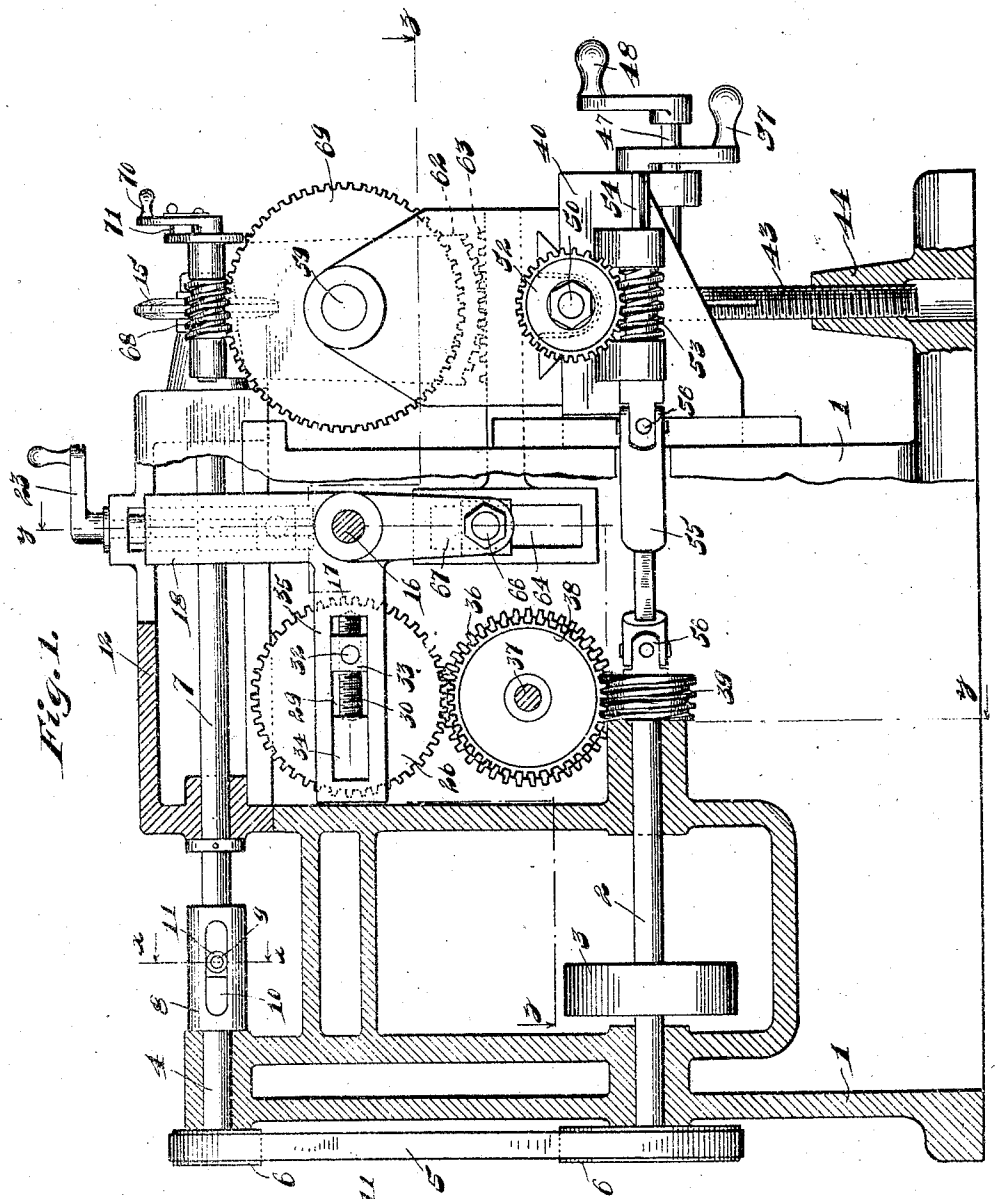

Fig. 1.

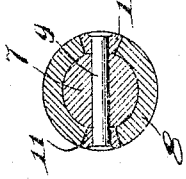

Fig. 2.

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3 SHEETS—SHEET 2.

Fig. 3.

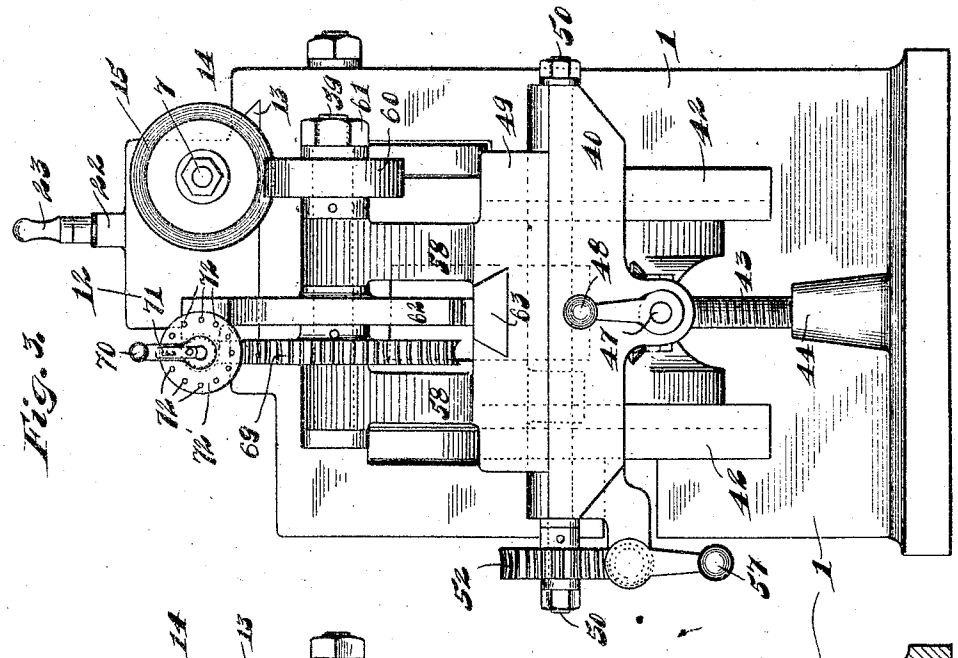
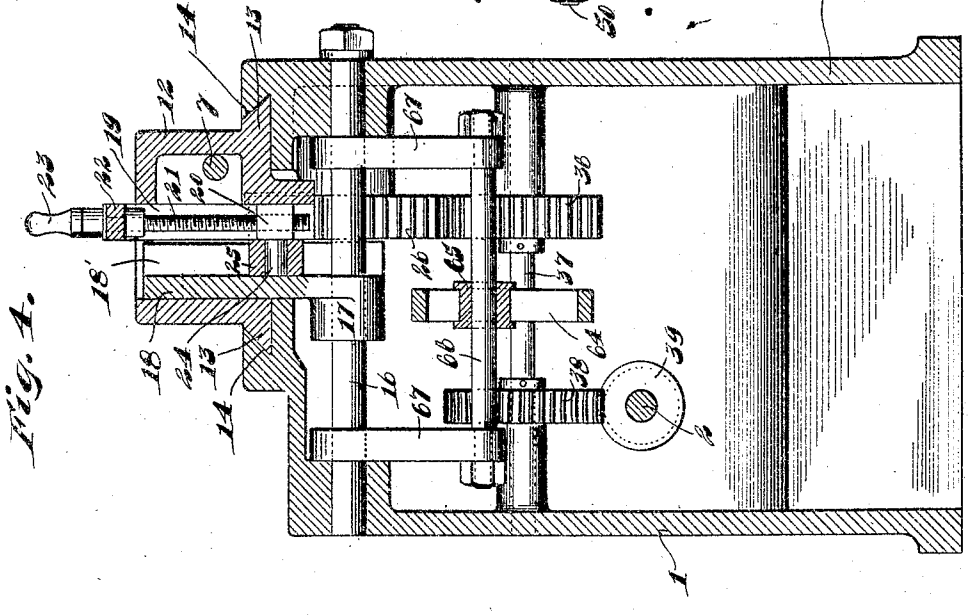


Fig. 4.



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3 SHEETS—SHEET 3.

Fig. 5.

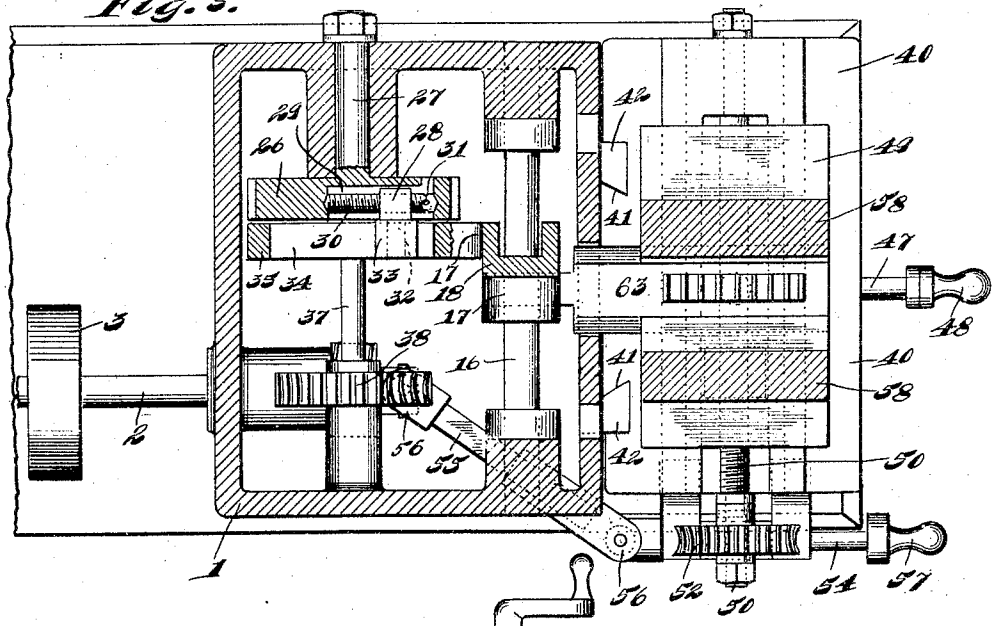

Fig. 6.

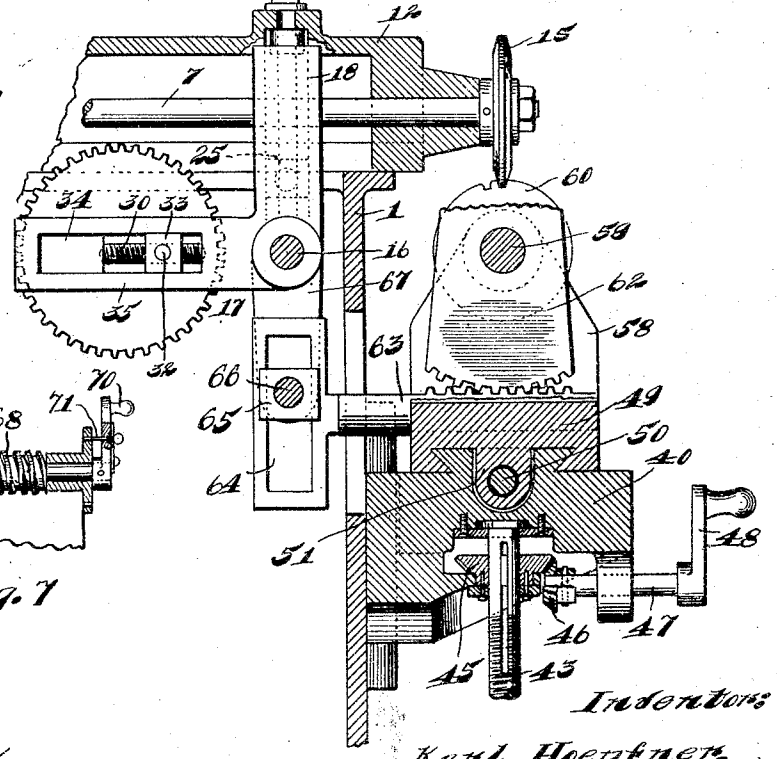

Fig. 7

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UNITED STATES PATENT OFFICE.

KARL HOEPFNER, OF CINCINNATI, OHIO.

GEAR-GENERATING MACHINE.

1,054,846. Specification of Letters Patent. Patented Mar. 4, 1913.

Application filed April 1, 1912. Serial No. 687,841.

To all whom it may concern:

Be it known that I, KARL HOEPFNER, a subject of the Emperor of Germany, and a resident of the city of Cincinnati, county of Hamilton, and State of Ohio, have invented certain new and useful Improvements in Gear-Generating Machines, of which the following is a specification.

My invention relates to improvements in gear generating machines, and has for its object the production of a machine of this character which will be of improved construction and efficient in operation.

Other objects will appear hereinafter.

The invention consists in the combinations and arrangements of parts hereinafter described.

The invention will be best understood by reference to the accompanying drawings forming a part of this specification, and in which,

Figure 1 is a sectional side elevation of a gear generating machine embodying my invention, Fig. 2 is an enlarged detail section taken on line *x*—*x* of Fig. 1, Fig. 3 is a front elevation of the machine, Fig. 4 is a vertical transverse section taken on substantially line *y*—*y* of Fig. 1, Fig. 5 is a horizontal section taken on substantially line *z*—*z* of Fig. 1, Fig. 6 is a fragmentary vertical longitudinal section of the front end portion of the machine, and Fig. 7 is a sectional detail of a portion of the construction.

The preferred form of construction, as illustrated in the drawings comprises a supporting frame or body 1 in the lower end portion of which is rotatably mounted a longitudinally extending shaft 2, the latter being provided with a pulley 3 through the medium of which the same may be driven as desired. Mounted in the upper end of the machine adjacent one edge thereof is a shaft 4 which is operatively connected with the shaft 2 through the medium of a belt 5 which passes around coplanar pulleys 6. Arranged co-axial with the shaft 4 is a shaft 7, the shaft 7 being operatively connected with the shaft 4 by means of a sleeve 8 which is formed upon the adjacent end of shaft 4 and in which is slidably mounted the adjacent end of shaft 7, a transversely extending pin 9 provided in shaft 7 projecting through diametric longitudinally extending elongated slots 10 provided in the sleeve 8, rollers 11 being preferably provided upon the extremities of pin 9 to alleviate friction. With this construction it will be seen that an operative connection is established between the shaft 4 and the shaft 7 which permits of relative sliding or longitudinal movement of the shaft 7. The shaft 7 is rotatably mounted in a bearing member 12 which is slidably mounted in the upper end of frame 1, laterally projecting flanges 13 provided at the base of the member 12 dove-tailing with guides 14 provided at the upper side of said frame. Secured upon the forward end of the shaft 7 is the cutting element 15, the latter being circular in form and beveled at its periphery as clearly shown in the several views.

Arranged substantially central in the frame 1 below the member 12 is a transversely extending oscillatory bar 16 upon which is secured a bell crank lever 17. The arm 18 of the lever 17 projects upwardly through an opening provided in the upper side of the frame 1 and into the member 12 as clearly shown in Figs. 1, 4 and 6. Formed in the inner side of the member 12 adjacent the arm 18 is a guide groove or channel 19 in which is slidably mounted a block 20. The block 20 is carried by a screw 21 which extends longitudinally of the groove 19 the upper end of said screw being rotatably mounted in a bearing portion 22 formed upon the upper side of the member 12, the arrangement being such that longitudinal adjustment of the block 20 in the groove 19 will be effected by rotation of said screw. The upper end of said screw is provided with a crank handle 23 in order to facilitate manual rotation thereof, as mentioned. Projecting from the block 20 is a stud 24 upon which is mounted a block 25 which is slidably mounted in a guide groove or channel 18′ which is formed in the adjacent side of the arm 18. With this arrangement it will be seen that upon oscillation of the bell crank 17, reciprocatory movement will be imparted to the member 12 and hence to the cutting element 15, which is carried thereby. Also, with this arrangement it will be seen that, adjustment of the amplitude of oscillation of the member 12 may be effected by adjusting the position of the block 20 in the groove 21, it being clear that by adjusting said block toward the upper end of said groove the amplitude of reciprocation of the member 12 will be increased and that by adjusting said block toward the lower end of said groove, or

closer to the fulcrum of the lever 17, the amplitude of oscillation of said member will be decreased.

Oscillation of the lever 17 as just mentioned is secured through the employment of a gear 26 which is mounted upon a stub shaft 27 mounted in the frame 1, as clearly shown in Fig. 5. In the gear 26 is arranged a block 28 which is slidably mounted in a radially disposed slot 29 formed in said gear, said block being adjustably held in said groove by means of a screw 30 which is in threaded connection with said block, the respective extremities of said screw being rotatably mounted in the end walls of said slot. In order to provide for longitudinal adjustment of the block 28 in the slot 29, one end of the screw 30 is provided with radial slots 31 which may be engaged by the point of a tool, such as a nail to effect rotation of said screw and hence longitudinal adjustment of said block, as will be readily understood. Projecting from the block 28 is a stud 32 upon which is loosely mounted a block 33 which is slidably mounted in an elongated slot 34 provided in the other arm 35 of the bell crank 17. With this arrangement it will be observed, that oscillation of said lever is effected upon rotation of the gear 26, regulation of the amplitude of oscillation of said bell crank being effected by adjustment of the position of the block 28 in the slot 29, as above mentioned. The gear 26 meshes with a gear 36 which is secured upon a transversely extending shaft 37 which is mounted in the frame 1, as shown in the several views. Secured also upon the shaft 37 is a worm wheel 38 which meshes with a worm 39 carried by the shaft 2. Thus an operative connection is established whereby reciprocation of the cutter 15 will be effected upon rotation of the shaft 2, this rotation of the latter also effecting simultaneous rotation of said cutting elements, as above described.

Arranged at the front side of the frame 1 is a vertically adjustable table 40, grooves 41 provided in the inner side of said table slidably engaging dove-tail guide bars 42 formed upon the front side of the frame, as clearly shown in Figs. 1 and 3. Said table is supported upon the upper end of a screw 43 which is threaded at its lower end in a boss 44 formed upon the base of frame 1, the upper end of said screw being in swiveled connection with the under side of the table 40, as clearly shown in Fig. 6. Rotatably mounted at the under side of the table 40 is a bevel gear 45 which is in spline connection with the screw 43. Meshing with the gear 45 is a bevel gear 46 which is carried at the inner end of a shaft 47 mounted at the under side of table 40, the arrangement being such that rotation of said shaft will effect rotation of the screw 43 and hence vertical adjustment of the table 40. A crank handle 48 is provided at the forward end of the shaft 47 for effecting manual rotation thereof.

Slidably mounted upon the upper side of the table 40 is a carrier 49 which is in dove-tail connection with said table, as clearly shown in Fig. 6. Sliding of the member 49 upon the table 40 is secured by means of a screw 50 which is rotatably mounted at its opposite ends in said table, the central portion of said screw being in threaded connection with a lug 51 which depends from the under side of the member 49. With this arrangement it will be seen that rotation of said screw will effect sliding of the holder 49 upon the table 40. Provided upon one end of the shaft 50 is a worm wheel 52 which meshes with a worm 53 which is secured to a shaft 54 mounted in bearings provided at one end of table 40. The shaft 54 is operatively connected with the shaft 2 through the medium of an extensible link 55 which is connected at its respective extremities with the shafts 2 and 54 by means of universal joints or knuckles 56. With this arrangement it will be seen that rotation of the shaft 2 will also effect sliding movement of the holder 49 upon the table 40 but at a very slow speed. A crank handle 57 is provided at the forward end of the shaft 54 for effecting manual rotation of the latter. By this arrangement it will be observed that the cutter and work make a large number of reciprocations and oscillations in unison with each other while the work is moving past the cutter, so that the portions cut during each reciprocation and oscillation will be so close together and vary so little from each other that they will constitute practically one continuous cut.

Arising from the holder 49 are spaced bearing arms 58 in the upper ends of which is rotatably mounted a shaft 59. The shaft 59 serves as the work-holding member or element, the work or gear blank 60 which is to be operated upon, being secured upon said shaft by means of a nut 61, as clearly shown in Fig. 3. The shaft 59 is so arranged that the work 60 which is mounted thereon will be positioned for engagement with the cutter 15 and so that when said work 60 is moved past the cutter 15, by movement of the holder 49, a cut will be made in the member 60 to form a tooth therein.

Loosely mounted upon the work-holding shaft 59 is a segmental gear 62, the gear teeth at the lower end thereof meshing with a rack bar 63 which is mounted for transverse sliding in the holder 49. The rearward end of the rack bar 63 is formed with a vertically extending elongated slot 64, in which is slidably mounted a block 65. Ex-

tending through the block 65 is a bar 66 the extremities of which are secured in the lower ends of rocker arms 67 secured to and depending from the shaft 16. With this arrangement it will be seen that oscillation of the segmental gear 62 will be effected by reciprocation of the rack bar 63, such reciprocation of the latter being secured by connection thereof with the bell crank 17 through the block 65, the bar 66 and the arms 67.

Mounted in the upper end of the segmental gear 62 is a worm 68 which meshes with a worm wheel 69 secured to the shaft 59. An operative connection is thus established between the segmental gear and the work-holding shaft 59 so that upon oscillation of said segmental gear, as above mentioned, corresponding oscillatory movement will be imparted to the work member 60. Connected with the worm 68 is a crank handle 70 whereby said worm may be rotated in order to rotatably adjust the work relative to the oscillating means therefor, namely the segmental gear 62. In operation such adjustment of the work is necessary in order to present new portions of the gear blank for cutting teeth or grooves therein. The worm 68 and hence the work is held in positions of adjustment relative to the segment 62 by means of a spring-held retractable pin 71 which is slidably mounted in the handle 70 and which is adapted to engage any one of a plurality of perforations 72 provided in a disk 72′ formed at the upper end of the gear 62, as clearly shown in Figs. 7 and 3. With this arrangement it will be seen that in order to rotatably adjust the work it is first required to retract the pin 71 and then to rotate the handle 70. By providing a plurality of perforations 72 which are uniformly spaced, in cutting the gear teeth it is only required to intermittently rotate the handle 70 and engage the pin 71 thereof successively with each of the perforations 72, the perforations thus serving to uniformly space the teeth which will be formed in the gear blank.

In the operation of the machine, the various parts will be so adjusted that the speed of reciprocation of the cutter 15 will correspond with the peripheral speed of oscillation of the work member or gear blank 60, the cutter and work member or gear blank thereby being moved in unison. The reciprocatory movement of the cutter together with the oscillatory movement of the gear blank will effect the formation of a groove in the gear blank which will form a gear tooth of proper cycloidal form. The various adjustments afforded render it possible to maintain this uniform speed regulation of the movement of the cutter and of the periphery of the work member or gear blank irrespective of the diameter of the blank or cutter used. The vertical adjustment which is afforded the table 40 affords means for regulating the depth of the cut and also affords means for accommodating gear blanks of various diameters since with this provision the gear blank may be moved toward or from the cutter, as desired.

A gear generating machine of the construction set forth is durable and economical and is of high efficiency in operation.

While I have illustrated and described the preferred form of construction for carrying my invention into effect, this is capable of variation and modification within the scope of the claims without departing from the spirit of the invention. I, therefore, do not wish to be limited to the precise details of construction set forth, but desire to avail myself of such variations and modifications as come within the scope of the appended claims.

Having described my invention what I claim as new and desire to secure by Letters Patent is:

1. In a machine of the character described, the combination of a reciprocatory cutting element; an oscillatory work-holding member; and means for reciprocating said cutting element and oscillating said work-holding member so that the speed of reciprocation of said cutting element will correspond with the peripheral speed of the work carried by said work-holding member, substantially as described.

2. In a machine of the character described, the combination of a reciprocatory rotary cutting element; an oscillatory and axially movable work-holding member; and means for driving said cutting element and said work-holding member so that the speed of reciprocation of said cutting element will correspond with the peripheral speed of the work carried by said work-holding member, substantially as described.

3. In a machine of the character described, the combination of a reciprocatory rotary cutting element; an oscillatory and axially movable work-holding member, said cutting element reciprocating in the same plane as that in which the work is oscillated by said work-holding member; and means for driving said cutting element and said work-holding member so that the speed of reciprocation of said cutting element will correspond with the peripheral speed of the work carried by said work-holding member, substantially as described.

4. In a machine of the character described, the combination of a reciprocatory rotary cutting element; an oscillatory and axially movable work-holding member, said cutting element reciprocating in the same plane as that in which the work is oscillated by said work-holding member; means for driving said cutting element and said work

holding member so that the speed of reciprocation of said cutting element will correspond with the peripheral speed of the work carried by said work-holding member; and means for rotatably adjusting the work relative to the driving means therefor, substantially as described.

5. In a machine of the character described, the combination of a reciprocatory rotary cutting element; an oscillatory and axially movable work-holding member, said cutting element reciprocating in the same plane as that in which the work is oscillated by said work-holding member; means for driving said cutting element and said work-holding member so that the speed of reciprocation of said cutting element will correspond with the peripheral speed of the work carried by said work-holding member; and means coöperating with said work-holding member for rotatably adjusting the work carried thereby relative to the driving means therefor, substantially as described.

6. In a machine of the character described, the combination of a reciprocatory rotary cutting element; an oscillatory work-holding member, said work-holding member being movable to feed the work transversely of the axis of said cutting element, said cutting element reciprocating in the same plane as that in which the work is oscillated by said work-holding member; driving means; an operative connection between said cutting element and said work-holding member whereby the speed of reciprocation of said cutting element will correspond with the peripheral speed of the work carried by said work-holding member; manually operable means coöperating with said work-holding member for rotatably adjusting the work carried by the latter relative to the driving means for said work-holding member; and means for releasably locking said work-holding member in positions of adjustment, substantially as described.

7. In a machine of the character described, the combination of a reciprocatory rotary cutting element; an oscillatory work-holding member; oscillatory means for reciprocating said cutting element and for oscillating said work-holding member, said work-holding member being movable to feed the work transversely of the axis of said cutting element; means for moving said work-holding member to feed the work, said cutting element reciprocating in the same plane as that in which the work is oscillated by said work-holding member; driving means; and an operative connection between said cutting element and said work-holding member whereby the speed of reciprocation of said cutting element will correspond with the peripheral speed of the work carried by said work-holding member, substantially as described.

8. In a machine of the character described, the combination of a reciprocatory rotary cutting element; an oscillatory work-holding member; an oscillatory lever for simultaneously reciprocating said cutting element and oscillating said work-holding member, said work-holding member being movable to feed the work transversely of the axis of said cutting element; means for moving said work-holding member to feed the work; said cutting element reciprocating in the same plane as that in which the work is oscillated by said work-holding member; driving means; and an operative connection between said cutting element and said work-holding member whereby the speed of reciprocation of said cutting element will correspond with the peripheral speed of the work carried by said work-holding member, substantially as described.

9. In a machine of the character described, the combination of a reciprocatory rotary cutting element; an oscillatory work-holding member; an oscillatory lever for simultaneously reciprocating said cutting element and oscillating said work-holding member; means for adjusting the throw of said lever in actuating said cutting element and said work-holding member, said work-holding member being movable to feed the work transversely of the axis of said cutting element, said cutting element reciprocating in the same plane as that in which the work is oscillated by said work-holding member; and driving means for moving said work-holding member to feed the work transversely of said cutting element and for rotating said cutting element and oscillating said lever, substantially as described.

10. In a machine of the character described, the combination of a reciprocatory rotary cutting element; an oscillatory and axially movable work-holding member, said cutting element reciprocating in the same plane as that in which the work is oscillated by said work-holding member; means for driving said cutting element and said work-holding member so that the speed of reciprocation of said cutting element will correspond with the peripheral speed of the work carried by said work-holding member; and means for adjusting said work-holding member toward and from said cutting element, substantially as described.

11. In a machine of the character described, the combination of a reciprocatory rotary cutting element; an oscillatory work-holding member, said work-holding member being movable to feed the work transversely of the axis of said cutting element, said cutting element reciprocating in the same plane as that in which the work is oscillated by said work-holding member; driving means; an operative connection between said cutting element and said work-holding mem-

ber whereby the speed of reciprocation of said cutting element will correspond with the peripheral speed of the work carried by said work-holding member; manually operable means coöperating with said work-holding member for rotatably adjusting the work carried by the latter relative to the driving means for said work-holding member; means for releasably locking said work-holding member in positions of adjustment; and means for adjusting said work-holding member toward and from said cutting element, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

KARL HOEPFNER.

Witnesses:
MARY A. MESCH,
WM. F. ROGGE.