(No Model.) 2 Sheets—Sheet 1.

W. C. JONES.

GEAR CUTTER.

No. 367,047. Patented July 26, 1887.

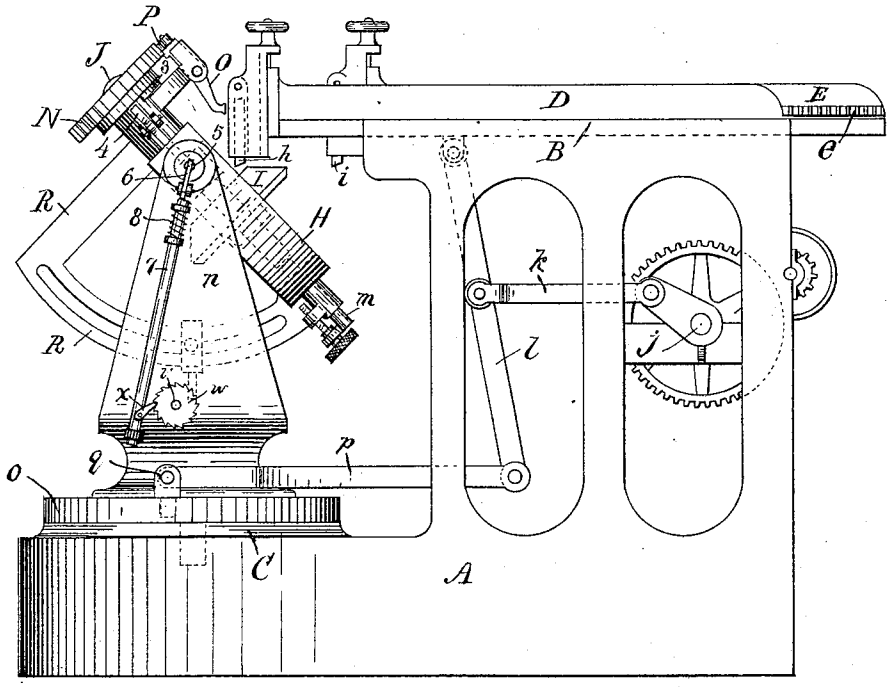

Fig. 1.

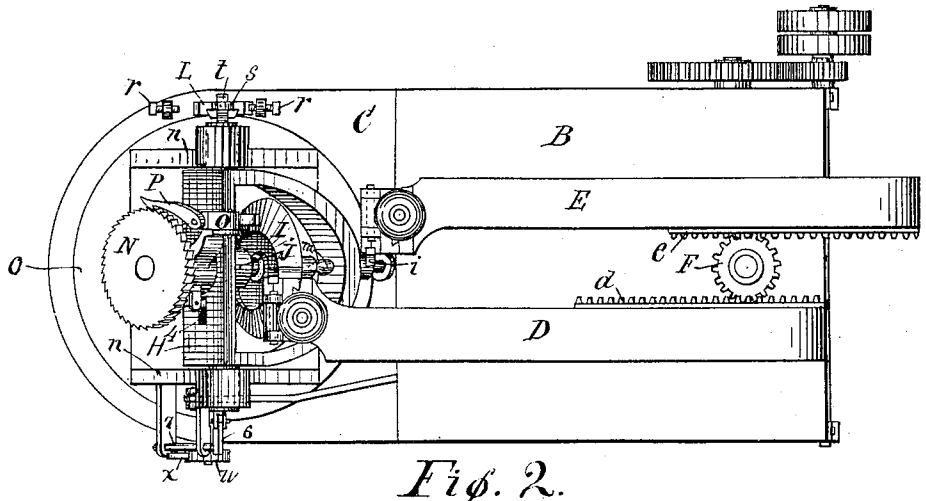

Fig. 2.

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(No Model.) 2 Sheets—Sheet 2.

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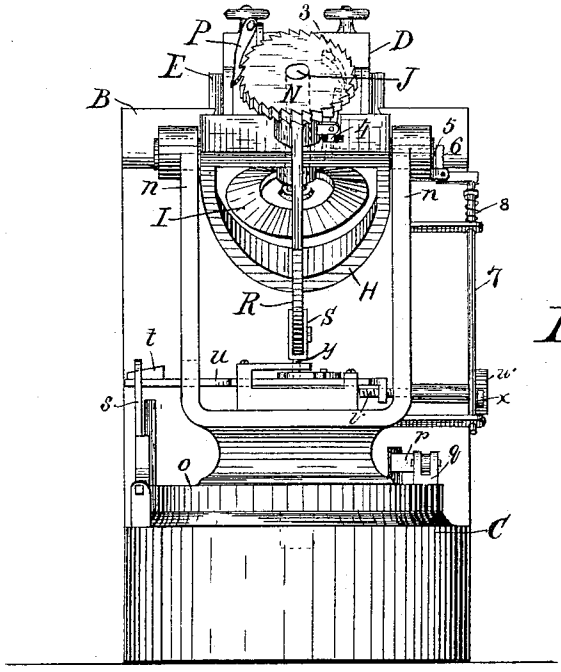


Fig. 3.

Fig. 4.

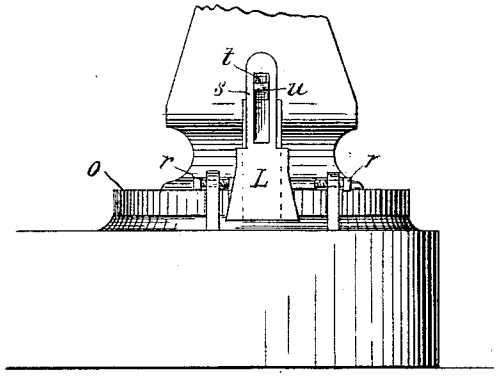
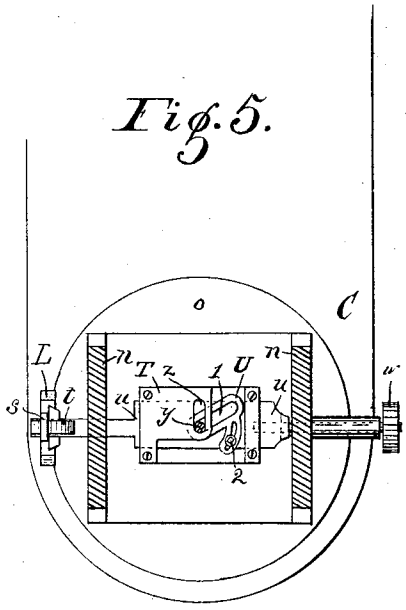


Fig. 5.



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UNITED STATES PATENT OFFICE.

WILLIS C. JONES, OF HAMILTON, OHIO.

GEAR-CUTTER.

SPECIFICATION forming part of Letters Patent No. 367,047, dated July 26, 1887.

Application filed December 30, 1886. Serial No. 222,962. (No model.)

To all whom it may concern:

Be it known that I, WILLIS C. JONES, a citizen of the United States, residing at Hamilton, in the county of Butler and State of Ohio, have invented a new and useful Improvement in Gear-Cutters, of which the following is a specification.

My invention relates to an improved machine for cutting the teeth of bevel gear-wheels of that class in which the teeth are formed by reciprocating cutters.

The objects of my improvement are to so arrange a pair of reciprocating cutters that their line of cut shall be practically in the same path, and to provide means whereby the gear-blank shall be automatically so presented to said cutters that all of the cut surfaces of the teeth shall be on lines radial to a common center, all as hereinafter fully described.

The accompanying drawings illustrate my invention.

Figure 1 is a side elevation. Fig. 2 is a plan. Fig. 3 is an end elevation. Fig. 4 is a partial elevation of the side opposite that shown in Fig. 1. Fig. 5 is a partial plan.

A designates the casting forming the bed-frame, having two platens or tables, B and C.

D and E are a pair of sliding tool-heads mounted in suitable parallel ways in platen B. Rack-bars *d* and *e* are secured to the opposite sides of tool-heads D and E, and between them, mounted on a stud projecting from the bed-frame, is a pinion, F, arranged to intermesh with both rack-bars, the purpose being to cause the tool-heads to move in opposite directions when motion is imparted to one of them, as hereinafter described. A pair of cutters, *h* and *i*, are secured in opposite sides of the respective tool-heads. These cutters are adapted to cut on their lower ends and opposed edges, and are arranged so that their cutting-edges shall move as nearly as possible in the same path on a line central between the two. A reciprocating motion is imparted to tool-head D by means of a crank-shaft, *j*, connecting-rod *k*, and lever *l*.

H is a swinging frame, in which the gear-blank I is mounted, the blank being secured to a mandrel, which is rigidly secured at one end to a revoluble spindle, J, mounted in one side of the frame, and is supported at the other end on a center, *m*.

Frame H is provided with journals, which rest in bearings in a pair of standards, *n n*, which rise from a circular base, *o*, the arrangement being such that frame H may swing in a vertical plane between the standards. The base *o* is pivoted at its center to the platen C of the bed-frame, so as to turn thereon in a horizontal plane, and an oscillating movement is imparted to the base *o* and the frame H, which it supports, by means of a rod, *p*, which is connected at one end to a stud, *q*, pivoted to the base, and at the other end to the lower end of lever *l*.

For the purpose of controlling and adjusting the degree of oscillation in base *o*, a tapered gage-block, L, is arranged to move in vertical ways on the base, and a pair of set-screws, *r r*, are arranged in lugs projecting from the bed-frame, so as to intercept the gage-block as it moves laterally with the base.

It will be observed that when the gage-block is slid downward, so that its narrow portion is opposite the set-screws, there will be a certain space between the edges of the gage-block and the ends of the screws, thus permitting a limited movement of the base, and that when the gage-block is drawn up, so as to present its wider portion between the screws, the movement of the base will be shortened.

For the purpose of raising the gage-block, a vertically-slotted arm, *s*, projects from the upper end of the gage-block, and a tapered block, *t*, mounted on a bar, *u*, is moved by means of a screw, *v*, transversely through the slotted arm, engaging its upper end. Said screw is turned by means of a ratchet-wheel, *w*, and pawl *x*, as will be hereinafter explained.

Secured to the outer end of spindle J, so as to revolve therewith, is a ratchet-wheel, N, which is turned step by step by means of a trip-lever, O, mounted on an arm projecting from frame H and engaging wheel N by means of the pawl P, which is pivoted to the trip-lever. The trip-lever is actuated at each forward movement of the tool-head E by the tool-head coming in contact with the lower end of the lever. On the under side of ratchet-wheel N is a projection, 3, having its inner face ec-

centric to the periphery of the ratchet-wheel. At each revolution of the ratchet-wheel said projection 3 engages the upper end of the lever 4, and in passing draws that end of the lever inward and operates through the lever a rod, 5, and bell-crank lever 6 to depress the rod 7, on which the pawl *x* is mounted. The downward movement of rod 7 compresses a spiral spring, 8, so that when projection 3 has passed the lever rod 7 is drawn upward by the recoil of the spring and pawl *x*, engaging the ratchet-wheel *w*, screw *v* is turned, and bar *u* is pushed forward.

For the purpose of adjusting frame H to the proper angle, a segmental arm, R, is secured to the under side of the frame concentric with its axis. On this arm is adjustably secured a sliding head, S, having a pin, *y*, which projects through a slot, *z*, in a fixed plate, T, mounted between the standards *n n* and into a slot, 1, in a plate, U, which is adjustably secured to the movable bar *u*. Plate U is secured to bar *u* by means of the bolt 2 in such a position that the slot 1 therein is more or less inclined to the path of movement of bar *u*, the result being that as bar *u* is moved forward the pin *y* is moved along the slot *z* in the fixed plate T.

The operation of the machine is as follows: The gear-blank, having been mounted on a mandrel, is secured in frame H in such a position that the point of intersection of the lines of its beveled face when extended diametrically will be coincident with the point of intersection of the axes of the frame H and spindle J. Cutters *h* and *i* are now so adjusted that the line of the path of movement of their lower inner corners, as the tool-heads move back and forth, will, when extended, pass through the point of intersection of the axes of frame H and spindle J. Frame H is now swung in its bearings, so as to bring the face of the gear blank a little above the path of the cutters, and is there secured and held in position by the pin *y* and slotted plate U, the pin resting at the outer end of slot *z* in plate T. The machine being now started, the first movement of the crank-shaft operates to swing the lower end of lever *l* toward the front of the machine, thus pushing rod *p* and turning the base *o* until gage-block L comes in contact with the farther set-screw *r*, thus stopping further movement of the base. Lever *l* now swings on the inner end of rod *p*, and the upper end of the lever, moving forward, carries the tool-head D forward, and the cutter *h* takes a chip across the face of the blank, defining one edge of the space between the teeth. The return movement of lever *l* first turns base *o* in the opposite direction till stopped by the opposite screw, *r*, thus moving the blank over sidewise the width of the desired space. The tool-head E is then moved forward by the backward movement of head D, as before explained, and cutter *i* takes a chip, defining the other edge of the space. As head E moves forward after the cutter has passed over the blank, it comes in contact with the lower end of the trip-lever O, thus turning, by means of the pawl P and ratchet-wheel N, the spindle J and the gear-blank forward one tooth. The teeth and spaces are thus outlined in succession to the depth of a single chip around the entire periphery of the blank. When the revolution of the blank is nearly completed, the projection 3 engages lever 4 and depresses rod 7, as before described, so that as the last cut is made and the space first cut is again presented to the cutters, projection 3 at the same time passing out of engagement with the lever, the recoil of spring 8 draws rod 7 upward and turns screw *v*, bar *u* and plate U being thereby moved forward. Pin *y* is moved inward, and the blank is raised the depth of another chip. Block *t* is at the same time pushed forward through arm *s*, thereby raising the gage-block L, thus shortening the oscillations of the gear-blank and narrowing the space between the teeth of the gear as it grows deeper. It will thus be seen that the shape of the teeth will depend on the outline of the tapered block *t*, and the depth of the space or length of the tooth will depend upon the relation of the slot 1 in plate U to the line of movement of bar *u*, and that all the cut surfaces must be radial to the point where the axes of the gear-wheel and frame H and the line of movement of the cutters intersect.

I claim as my invention—

1. In a gear-cutting machine, the combination of the following elements, namely: a pair of tool-heads mounted side by side and arranged to slide in a suitable bed-frame, and each carrying a cutting-tool, a revoluble shaft mounted in said frame, intermediate mechanism connecting said tool-heads and shaft, whereby the tool-heads are given a reciprocating movement in opposite directions, a frame carrying a revoluble spindle adapted to receive and hold a gear-blank in the path of movement of said cutting-tools, said frame being mounted so as to swing in a vertical plane on a support which is pivoted to the bed-frame and arranged to turn thereon in a horizontal plane, means for adjustably securing said swinging frame at different degrees of inclination, and intermediate mechanism connecting said support and the shaft, whereby the support is oscillated, as described, all arranged to co-operate substantially as and for the purpose specified.

2. The combination of the gear-blank support pivoted to the bed-frame so as to turn thereon in a horizontal plane, the pair of sliding tool-heads, the driving-shaft, and intermediate mechanism connecting said support, tool-heads, and driving-shaft, whereby the support is first turned and the tool-heads then propelled by the revolution of the shaft, substantially as and for the purpose specified.

3. The combination of the bed-frame having platen C, the support for the gear-blank

mounted thereon so as to turn in a horizontal plane, the tapered gage-block arranged to move vertically on said support, means for vertically adjusting said gage-block, and a pair of stops projecting from the bed-frame on opposite sides and in the path of the gage-block, all substantially as and for the purpose specified.

4. In a gear-cutting machine, the combination, with the base *o* and gage-block L, having the vertically-slotted arm *s*, of the tapered block *t*, bar *u*, and screw *v*, whereby the gage-block is adjusted vertically.

5. The combination of the bed-frame having platen C, the support for the gear-blank mounted thereon so as to turn and oscillate in a horizontal plane, the tapered gage-block arranged to move vertically on said support and having a slotted arm, a pair of stops projecting from the bed-frame on opposite sides and in the path of the gage-block, the tapered block mounted on the transverse sliding bar and arranged to engage said slotted arm of the gage-block, the revoluble spindle adapted to hold and turn the gear-blank, the ratchet-wheel secured to said spindle, means for turning said ratchet-wheel and spindle step by step, and intermediate mechanism connecting said ratchet-wheel and said sliding bar, whereby the bar and its tapered block are pushed farther under the slotted arm and the gage-block thereby raised at the completion of each revolution of the ratchet-wheel, all substantially as and for the purpose specified.

6. The combination of the base *o*, having a pair of standards erected thereon, the frame H, arranged to swing on said standards and having the segment-arm R, the sliding head *s*, having pin *y*, the fixed plate T, having slot *z*, the movable plate U, having the inclined slot 1, the revoluble spindle J, mounted in frame H, the wheel secured to said spindle, means for turning said wheel and spindle step by step, and intermediate mechanism connecting said wheel and movable plate, whereby the plate is moved forward at the completion of each revolution of the wheel and the inclination of the frame H thereby changed, as and for the purpose specified.

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Witnesses:
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