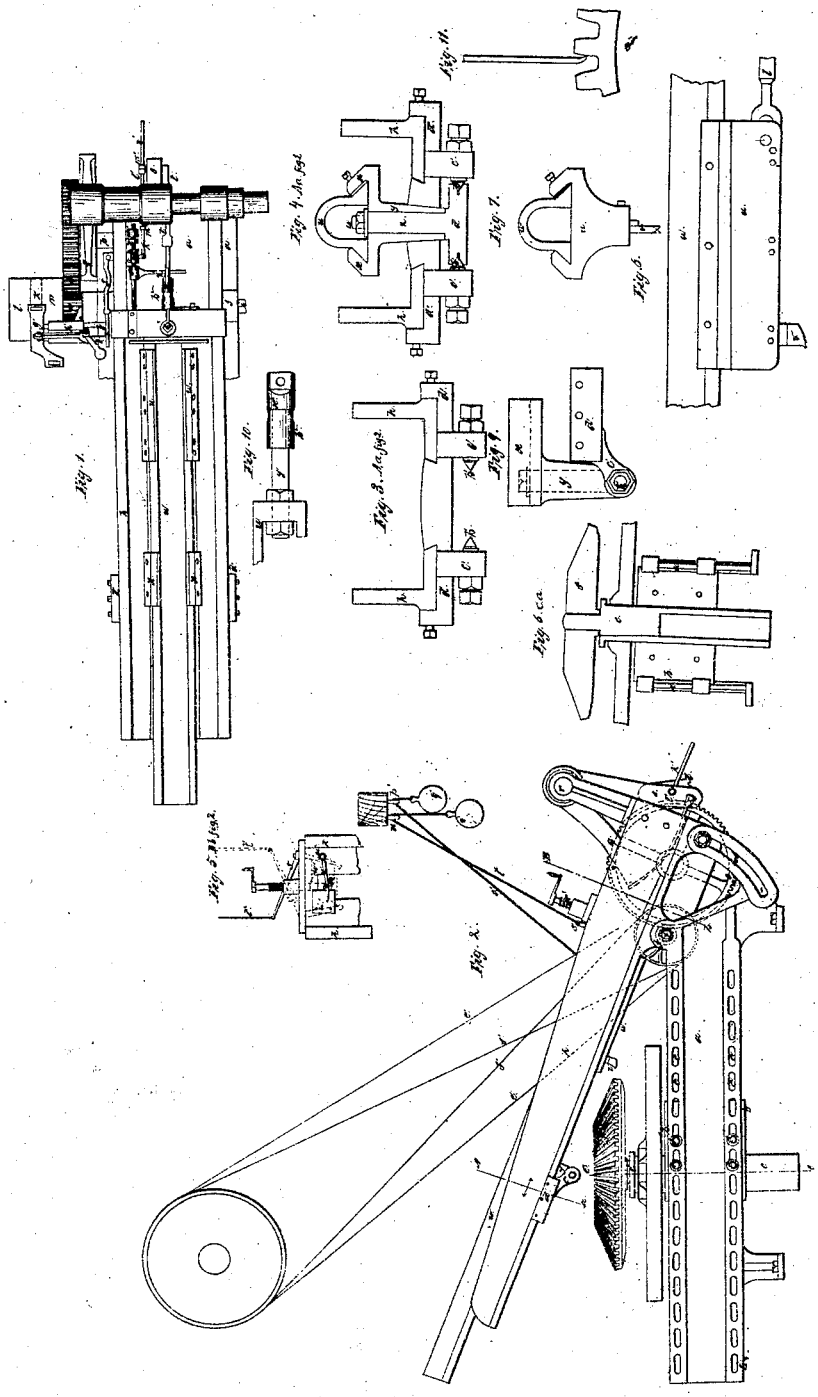
No. 6,161. PATENTED MAR. 10, 1849.

G. H. CORLISS.

MACHINE FOR CUTTING THE COGS OF BEVELED COG WHEELS.



UNITED STATES PATENT OFFICE.

GEO. H. CORLISS, OF PROVIDENCE, RHODE ISLAND.

MACHINE FOR CUTTING COGS OF BEVEL COG-WHEELS.

Specification of Letters Patent No. 6,161, dated March 10, 1849.

To all whom it may concern:

Be it known that I, GEORGE H. CORLISS, of Providence, in the county of Providence and State of Rhode Island, have invented a new and useful Machine or Engine for Cutting the Cogs of Bevel Cog-Wheels, and that the following is a full, clear, and exact description of the principle or character which distinguishes it from all other things before known, and of the manner of making, constructing, and using the same, reference being had to the accompanying drawings, making part of this specification, in which—

Figure 1 is a plan of the machine; Fig. 2, a side elevation; Figs. 3 and 4 enlarged cross sections taken at the line (A *a*) of Fig. 2—the former with certain parts removed; Fig. 5, another cross section at the line (B *b*) of Fig. 2; Fig. 6, a cross vertical section at the line (C, *c*) of Fig. 2; Figs. 7 and 8 enlarged end and side views of the cutter and carriage; Fig. 9, an enlarged separate view of the hinge which forms the axis of the guide bar on which the cutter carriage slides; and Fig. 10, an enlarged separate view of the end of the guide bar with a stem connected therewith.

The same letters indicate like parts in all the figures.

In the machines heretofore employed for cutting the cogs of toothed wheels a rotating burr cutter has been used, and although this is to a certain extent effective for cutting spur gear, yet in cutting the cogs of bevel gear it is, from the very nature of the case, defective. The cogs when cut with a rotating cutter must be defective for the following reasons. If the sides of the cutter wheel be parallel the space cut out between the cogs will also be parallel, whilst in bevel wheels they should be in the lines of the radii, that is, further apart at the outer than at the inner periphery, and if to avoid this the sides of the cutter wheel are beveled to make the spaces wider by cutting deeper toward the outer periphery, then the spaces will be wedge formed in their section, which is at variance with the proper formation of cogs, for the spaces below the pitch line should be vertical or curved inward and from the pitch line upward curved outward and these curves should be sections of cones which cannot be formed by a rotating cutter, which from the very nature of its operation will make the curve the same from end to end of the cog.

The object of my invention is to avoid this objection in cutting the cogs of bevel wheels, and to these ends the first part of my invention consists in the use of a reciprocating cutter governed by a guide bar on which the cutter carriage slides, and which has its axis of vibration, to adapt the cutter to the required depth of cogs, at the apex of a cone corresponding with the bevel of the wheel to be cut, whether such axis be fixed or adjustable to wheels of different sizes, that all the cuts may be in the direction of the radii.

The second part of my invention consists in combining the guide bar on which the cutter carriage runs with a secondary frame hinged to the main frame outside of the circle of the largest wheel intended to be cut in the machine, that the axis of vibration of the guide bar may be elevated or depressed to adapt the machine to different bevels, and that the main driving shaft, which communicates motion to the operative parts of the machinery placed at the hinged end of the said frame, may be in the line of the axis of vibration of the said frame that the vibration thereof may not change the relative position of the driving shaft and the parts receiving motion therefrom.

The third part of my invention consists in combining with the guide bar a guide plate against which it bears by means of a weight, spring, or the equivalent thereof, so that as the guide bar descends to give the proper depth to the cogs the said guide bar shall follow the curve of the guide and thus determine the form of the face of the cogs. And the last part of my invention consists in making that part of the rear end of the guide bar, which rests against the guide, movable, so as to have an endwise motion in or on the said bar in the direction of its length, the said movable part or stem being beveled back of where it rests against the guide, and so connected either with the guide bar or some other part of the machinery that at the time of the cutting motion it will move forward that its bevel surface may be brought in contact with the guide

and give a lateral motion to the guide bar to relieve the cutter from the surface of the cog that is being cut, to admit of its moving back clear of the cog, and then at the end of the return motion, a reversed motion to bring the cutter in the proper line for cutting.

In the accompanying drawings (*a*) represents the main frame of the machine, to the inside of which is adapted a frame (*b*) that carries the spindle (*c*) of an index plate made in the usual manner. This frame (*b*) is secured to the main frame by bolts (*d*, *d*) that pass through elongated holes (*e*, *e*) in the side pieces of the main frame and as there are several of these holes along the frame, the index plate can be moved to any place required on the main frame to adapt the machine to wheels of various sizes. The upper end of the spindle (*c*) is adapted like other cutting engines to receive the wheel (*f*) to be cut. A secondary inclined frame (*h*) is provided near one end with a shaft (*i*) the journals of which run in boxes (*j*, *j*) at the end of the main frame, so that the secondary frame can be inclined to any desired extent with the axis of the index wheel to determine the bevel of the cogs to be cut. And the extreme rear end of the secondary frame is provided with a bolt and temper screw that pass through a segment mortise in the main frame by means of which the secondary frame may be secured and held in place at any inclination required. The shaft (*i*) of the secondary frame extends out sufficiently on one side to receive one loose pulley (*k*) and two fast pulleys (*l*, *m*) one on each side of the loose pulley. The loose pulley (*k*) turns freely between and on the barrel of the other two, in manner well known to machinists. And the inner end of the barrel of the fast pulleys (*l*, *m*) is provided with a pinion (*n*) which engages and carries a cog wheel (*o*) that turns on a stud pin (*p*), and the arbor of this wheel carries a pinion (see dotted lines in Fig. 2) that engages and carries a sector rack (*q*) on the end of a rock shaft (*r*) provided with a pendulous arm (*s*) to the lower end of which is jointed a connecting rod (*t*), that takes hold of the rear end of a carriage (*u*) (as seen in Fig. 8) to which is secured the cutter (*v*) in any appropriate manner. The carriage slides on a guide bar (*w*) properly formed for this purpose, as shown in the drawings. and in turn this guide bar slides in ways (*x*) connected by a socket (*y*) with a stud (*z*) that projects from an arbor (*a'*) which turns on pivot screws (*b'*, *b'*) that pass through the two ears (*c'*, *c'*) of a plate (*d'*) secured by bolts or screws to the side pieces of the secondary frame, so that by shifting these screws the plate can be moved along the secondary frame as the index plate and its spindle can be moved along the main frame to adapt the machine to the cutting of wheels of various diameters. The guide bar is thus connected with the secondary frame by a universal joint, and the connection of the universal joint with the secondary frame can be shifted to adapt the machine to the cutting of wheels of different sizes, and as the axis of the vertical vibration of the guide bar must always be in the line of the axis of the index plate the mode of shifting either the one or the other must be such as will admit of accurate adjustment. For this purpose the holes in the main frame through which the securing bolts pass are elongated.

The machine is driven by two belts (*e'*) and (*f'*), one being crossed and the two governed by a double belt shipper (*g*) so formed that when the direct belt (*e'*) runs on the pulley (*m*) to give the cutting motion to the cutter carriage by the connection of parts from the pinion (*n*), the crossed belt (*f'*) runs on the loose pulley (*k*), and when the belts are shifted at the end of the cutting motion, to reverse the motion, the crossed belt runs on and carries the pulley (*l*) and with it the cutter carriage by the same connections, and the direct belt (*e'*) then runs on the loose pulley or if desired this arrangement of belts may be reversed. In this way the desired motions are given, and the shifting of the belts is effected in the following manner. The belt shipper is attached to the outer end of two rods (*i' i'*) that slide in a plate (*h'*) attached to the frame, and these way rods (*i' i'*), are connected by a cross bar (i^3) with one arm of a right angle lever (*j'*) the other arm of which passes to the inside of the main frame and is there jointed to a rod (*k'*) which passes through a thimble (*l'*) jointed to the pendulous arm (*s*) that communicates motion to the carriage. The rod (*k'*) is provided with two adjustable stops (*m'*, *m'*) on each side of the thimble and at such distance apart that when the pendulous arm (*s*) moves forward to effect the cutting motion, toward the end of this motion the thimble strikes one of the stops (*m'*) and shifts the belts to give the return motion, toward the end of which the other stop (*m'*) is struck to reshift the belts. In this way by simply varying the distance between the two stops (*m'*) any desired range of motion can be given to the cutter carriage to adapt it to the length of the cogs to be cut.

As before described, by reason of the universal joint connection the guide bar is free to move either vertically or horizontally and with it the cutter carriage which slides on it. Its rear end which is thus free to move is suspended to a cord (*o'*) which passes over a pulley (*p'*) with a counter weight (*q'*) attached to it, by which it is

held against the end of a set screw (r') the turning of which will therefore determine the depth of cut to be made by the cutter. This guide bar is also borne laterally by means of a bent lever (s') (see also Fig. 5) one arm of which acts against it and the other attached to a cord (t') that passes over a pulley (u') and is provided with a weight (v'). This weight awlays tends to bear the guide bar in one direction horizontally and against a guide plate (w') one edge of which is formed as to determine the form to be given to the face of the cog. And as this plate can be removed others may be substituted to suit the various and desired forms of cogs. The rear end of the guide bar (w) however does not bear against this guide plate, but, instead of this, there is a stem (x') with a socket in its forward end that slides accurately, but freely, on a projection (y') (see Fig. 10) from the rear end of the guide bar so that the one can slide on the other longitudinally; and this stem it is that bears against the guide plate. The rear end of the stem is looped to receive the arm (z') of a slide (a^2). It will be observed that while the stem is in the position represented in the drawings, as the rear end of the guide bar is moved up and down to cut the depth of the cog, the stem (x') follows the curvature of the guide (w') and therefore communicates a corresponding motion to the point of the cutter in a direction converging to the center of the universal joint on which the guide bar (w) vibrates, and that therefore any curve to be given to the cross section of the cog will be gradually reduced as it approaches the axis of the wheel. But when the cutter is to be moved back it is necessary that it should run clear of the metal, and for this purpose the stem (x') back of the part which is represented as bearing against the guide plate is curved inward or beveled as at (b^2) so that when this part is brought in contact with the guide plate a slight lateral motion is given to the guide bar sufficient to relieve the cutter. The required endwise motion for this purpose is given to the stem by the operation of shifting the belts to reverse the motion of the cutter. The inner arm of the lever (j') of the belt shifter carries a box (c^2) that slides freely on the slide (a^2), and toward the end of the forward motion of the cutter carriage this box strikes against a stop (d^2) from which the arm (z'), connected with the stem x', projects and forces forward the stem to the distance required to bring the bevel (b^2) against the guide plate (w') to relieve the cutter. The cutter carriage then runs back, and toward the end of this back motion the box on the lever of the belt shipper strikes another stop (e^2) on the slide (a^2) and moves back the stem to bring the cutter in the proper line for making its cut. In this way at each operation the cutter is relieved and returned to its proper position for cutting.

The cutter is fitted in any desired manner in a socket in the carriage, and when it is desired to cut cogs of the form represented in the enlarged Fig. 11, the cutting edge of the cutter must be bent forward as shown in that figure.

Various other arrangements of machinery may be substituted for the one herein specified to give the required movements to the cutter carriage, but I have specified the one which I deem the best and which I have essayed, for by this means the range of motion can be varied at pleasure to suit any desired length of cogs. In a machine constructed and operating on the principle of my invention every cut converges to the apex of a cone that represents the bevel of the wheel, and therefore the cogs and the spaces between them will gradually and in the true proportion diminish from the outer to the inner periphery.

So far I have described the mode of operation of the machine for cutting the faces of the cogs on one side, but as each cog has two faces on opposite sides so soon as one face of all the cogs have been cut the machine must be reversed to cut the other side, and for this purpose it is simply required to reverse the cutter (v), the guide plate (w') that guides the end of the guide bar to give the form to the face of the cogs, and the lever (s') which bears the guide bar against the guide plate. The reversed position of these parts is shown by dotted lines in Figs. 5 & 7. By the shifting of these parts it will be observed that the machine will cut the reversed side of the cogs.

The lower end of the cutter should be formed properly to give the required shape to the bottom of the cogs.

What I claim as my invention and desire to secure by Letters Patent, is—

1. The method of cutting the cogs of beveled wheels by means of a reciprocating cutter that moves in or on a slide (or slides) that vibrate on an axis that coincides, or nearly so, with the apex of a cone representing the bevel of the wheel to be cut, substantially as herein described, by which vibration the depth of cut is determined, and this I claim irrespective of the adjustment of the axis of vibration, as described.

2. I claim the guide bar, (or its equivalent,) on which the cutter carriage runs, and having its axis of vibration for the depth of cut as above described when combined with a secondary frame jointed to the main frame at some point outside of the circumference of the wheel to be cut, that the machinery may be adapted to the cutting of cogs on various bevels, substantially as described.

3. I claim in combination with the guide

bar having an universal joint, or the equivalent thereof and operated substantially as described; in combination with the guide plate, to guide the cutter and determine the form of the face of the cogs, as described.

4. I claim making that part of the guide bar which rests against the guide plate to determine the form of the face of the cogs separate from and movable on the guide bar and properly beveled to relieve and clear the cutter for its back movement, substantially as described.

GEORGE H. CORLISS.

Witnesses:
A. P. BOURNE,
E. P. MCCREA.