2 Sheets—Sheet 1.

C. E. J. GRUBE.

MACHINES FOR CUTTING BEVEL-GEAR WHEELS.

No. 175,972. Patented April 11, 1876.

Fig. 1.

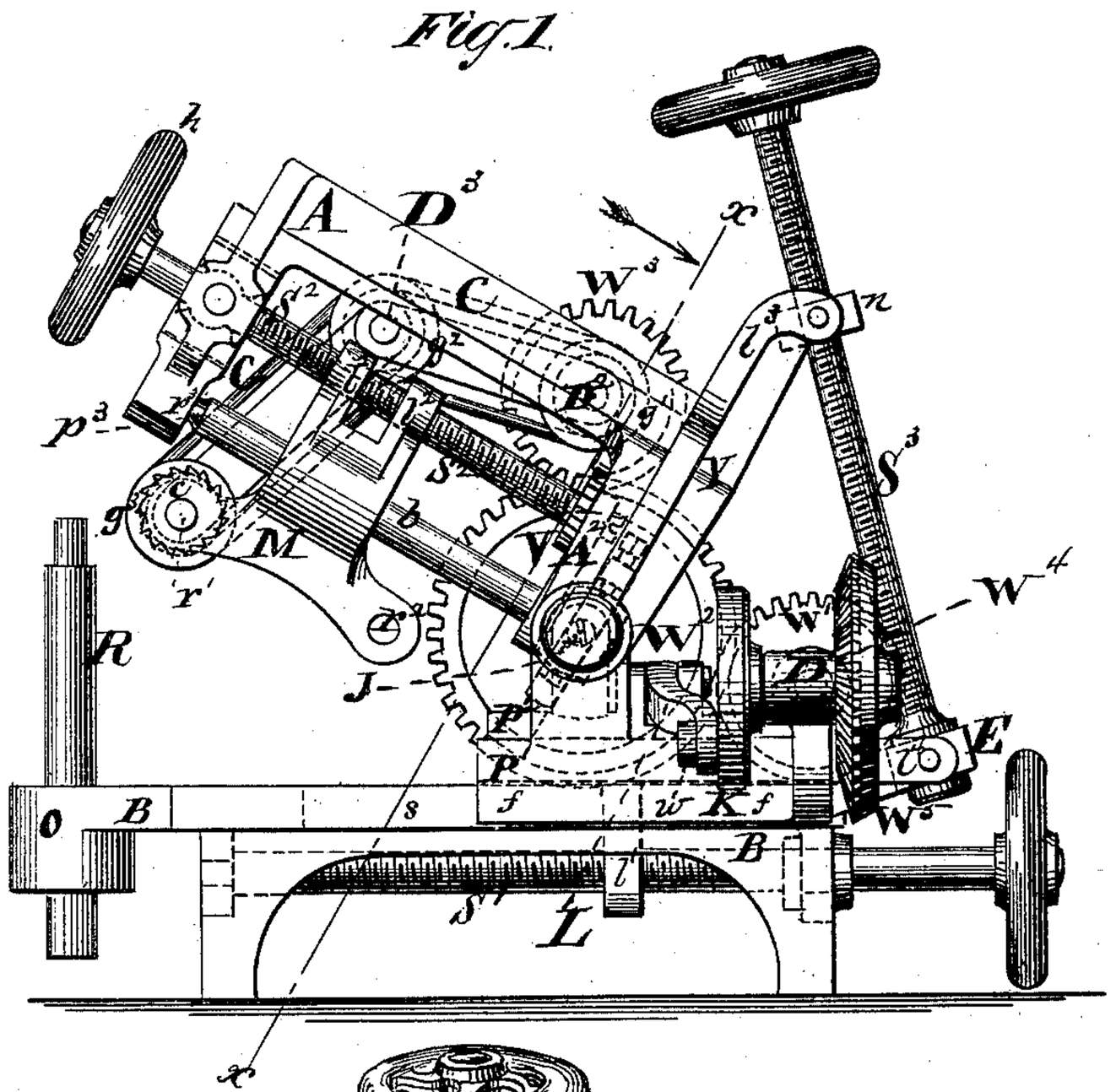
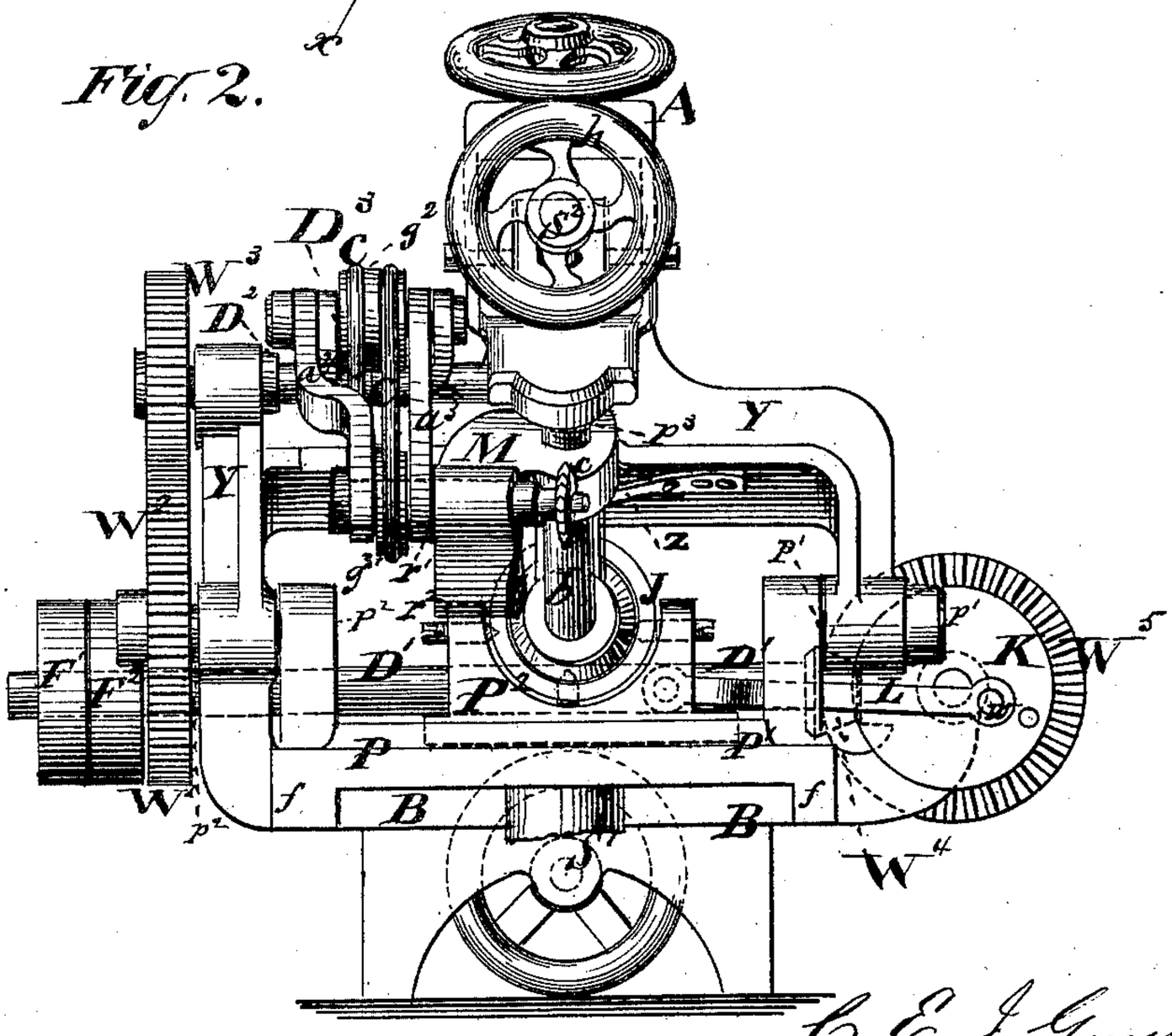


Fig. 2.



Witnesses.
John Becker
Fred. Haynes

C. E. J. Grube
by his Attorneys
Brown & Allen

2 Sheets—Sheet 2.

C. E. J. GRUBE.

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Fig. 3.

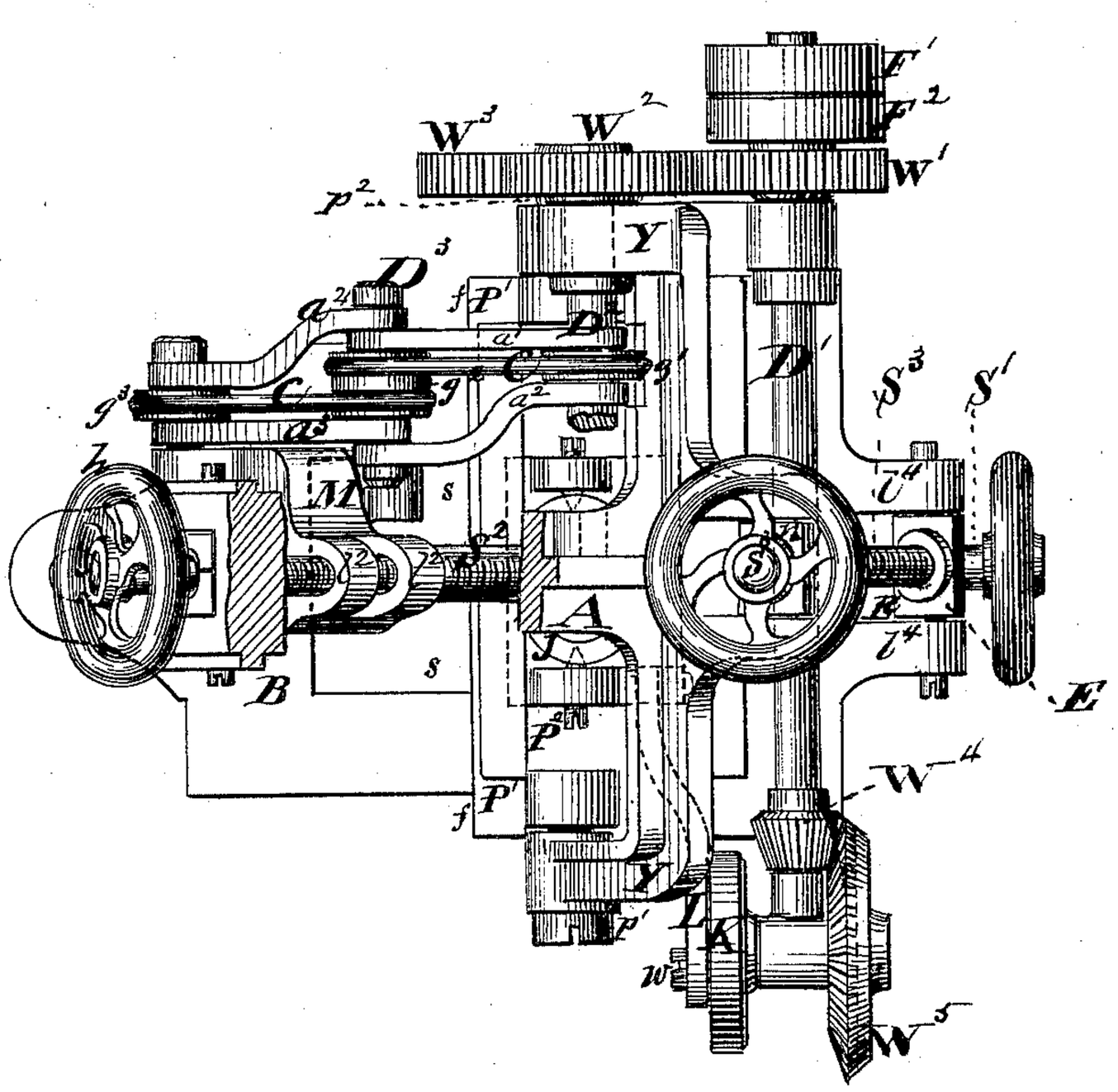
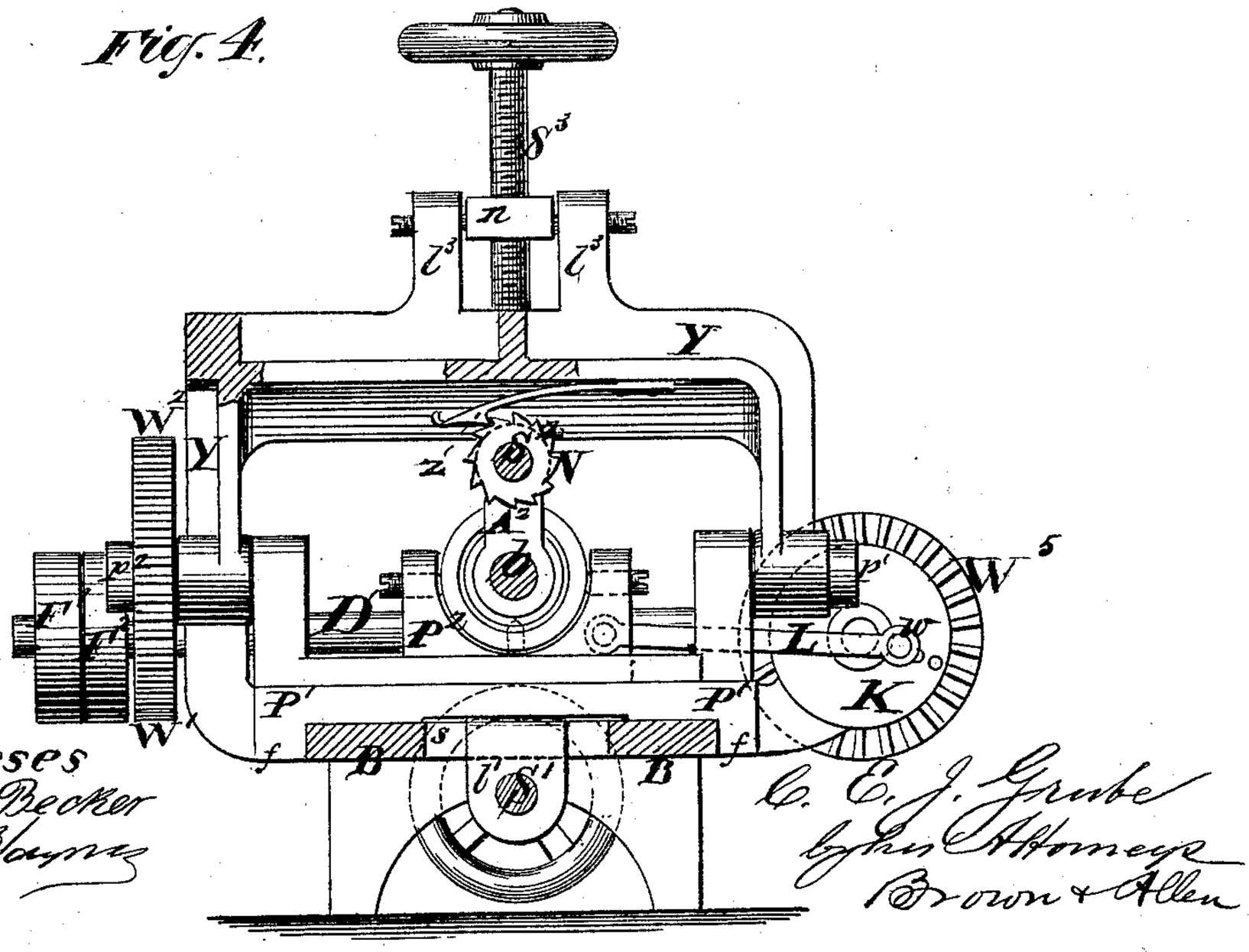


Fig. 4.



Witnesses
John Becker
Jno. Haynes

C. E. J. Grube
by his Attorneys
Brown & Allen

UNITED STATES PATENT OFFICE.

CORD E. J. GRUBE, OF HAMBURG, GERMANY, ASSIGNOR OF ONE-HALF HIS RIGHT TO JOHANN KAHLKE AND EMIL DETLEFSEN, OF SAME PLACE.

IMPROVEMENT IN MACHINES FOR CUTTING BEVEL-GEAR WHEELS.

Specification forming part of Letters Patent No. **175,972**, dated April 11, 1876; application filed February 16, 1876.

To all whom it may concern :

Be it known that I, CORD EDUARD JOHANNES GRUBE, of Hamburg, in the Empire of Germany, have invented a new and useful Improvement in Machines for Cutting Gear-Wheels; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawing, which forms a part of this specification.

My invention relates primarily to machines for cutting bevel or conical gears; but it may be applied to cutting crown-wheels, spur-gears, or worm-gears. The invention consists in a revolving cutter caused automatically to oscillate laterally while making its cut, the amplitude of such oscillation being made automatically to diminish toward the central axis of the gear while cutting the same, and increase toward the circumference, to give the proper contour to the teeth, and to the intervening spaces between the teeth of such gears, and the motion of the cutter toward or away from the central axis of the gear while cutting being automatically performed.

Figure 1 of the accompanying drawings is a side view of a gear-cutting machine comprising my improvement. Fig. 2 is an end view of the same. Fig. 3 is a top view of the same. Fig. 4 is a sectional view, the section being made on the line *x x* in Fig. 1.

Similar letters refer to like parts in all the figures.

B is the bed which supports all other parts of the machine. Upon the bed B is placed a sliding plate, P′, formed with flanges *f*, which bear against the edges of the bed B to guide the motion of the sliding plate P′, and render it always parallel to the parallel sides of the said bed. The screw S^1, which fits a thread in the lug *l′*, projecting downward from the plate P′ and playing in a slot, *s*, formed in the central part of the bed B, is employed to adjust the said plate longitudinally in relation to the said bed.

To the said plate P^1 is pivoted at p^1 p^2, a yoke, Y, the pivot p^2 also forming a bearing for the spur-wheel W^2. From the central and upper part of the yoke Y projects an arm, A, the end of which, remote from said yoke, bends downward and has pivoted to it at p^3 one end of the rigid bar *b*, the other end of the said bar being, by a universal joint, J, attached to a sliding plate, P^2, which slides transversely in parallel ways upon the top of the sliding plate P^1, at right angles with the longitudinal axis of the screw S^1.

Upon the bar *b* plays the cutter-slide M, in the lower part of which are formed bearings r^1 r^2 for the spindle of the revolving cutter *c*. The cutter-slide M is caused to slide upon the bar *b* by the action of the screw S^2, which is fitted to female screws in the lugs l^2, formed upon the upper part of the said cutter-slide. The screw S^2 also aids in supporting the cutter-slide M. The screw S^2 may be actuated by the hand-wheel *h*, but it is when in use automatically turned, as hereinafter described.

The spindle of the cutter *c* is driven from the main shaft D′ by the spur-wheels W^1 W^2 W^3, motion being thus imparted to the shaft D^2. The said shaft D^2 forms the main supporting-pivot for the inner ends of the pivoted arms a^1 a^2, which are pivoted at their opposite ends to the arms a^3 a^4, the said arms a^3 a^4 being pivoted to the spindle or shaft of the cutter *c*, so as to support the shaft D^3, and with it the outer ends of the arms a^1 a^2. Upon the shafts D^2 and D^3, and upon the spindle of the cutter *c*, are placed pulleys g^1 g^2 g^3, preferably grooved, upon which pulleys run the belts or bands C and impart rotary motion to the cutter *c* from the shaft D^2. I prefer to make the belts C of metallic chains, but other materials may be employed.

Upon the end of the main shaft D^1, next the spur-wheel W, are placed the fast pulley F^1 and the loose pulley F^2, the said fast pulley imparting motion to all the other parts of the machine. On that end of the shaft D farthest from the pulleys F^1 F^2 is keyed a bevel-wheel, W^4, which meshes into another bevel-wheel, W^5, the wheel W^5 being keyed to the shaft of the crank-wheel K. The crank-wrist *w* of the crank-wheel K actuates the pitman L, which is pivoted to the sliding plate P^2.

As before described, the sliding plate P^2 carries the bearing for the inner end of the

cutter slide-bar *b*, said bearing being attached to the said sliding plate P^2 by a universal joint, J. From the lower part of the said bar *b* rises an arm, A^2, fixed to said bar *b*, and having at the upper end a bearing for the inner end of the screw S^2. Upon the said inner end of the screw S^2 is fixed a ratchet-wheel, V, and upon the under side of the yoke Y is attached a spring-pawl, *z*, which actuates the said ratchet-wheel when the machine is at work. To the lugs l^3, on the top of the pivoted yoke Y, is attached a swiveled nut, *n*, in which is fitted a screw, S^3, the lower end of which plays in a swiveled bearing, E, pivoted to lugs l^4 on the sliding plate P^1. By the action of the screw S^3 the yoke is rotated on the pivot p^1 p^2, so that the cutter-slide bar *b* may be made to assume any angle with the plane of the bed B that may be desired. Graduated arcs may be attached to one or both the pivots, p^1 p^2, or to the yoke, which, with suitable indexes, will indicate the angle of inclination to the bed B of the cutter-slide bar *b*. In a projection, O, formed on the end of the bed B, is inserted a fixed mandrel, R, for the support of the gear to be cut.

The operation of the machine is as follows: The gear to be cut is placed upon the mandrel R, which fits the central hole of the hub of said gear. The cutter-slide bar *b* is then made to assume the proper angle to cut the spaces between the teeth of the gear to correspond with the required bevel or conicalness of the said gear. By the hand-screw S^2, the cutter-slide is slid along the bar *b* till it will commence its cut at the larger circumference of the gear, the cutting preferably proceeding from the outer portion toward the inner portion of the gear. These adjustments having been made, the belt is run off the loose pulley F^2 and on the fast pulley F^1. The main shaft, then, through the wheels W^1 W^2 W^3, imparts motion to the system of pulleys g^1 g^2 g^3 and their belts, and causes the cutter-spindle and the cutter to rotate rapidly. At the same time, through the bevel-gears W^4 W^5, the crank-wheel *w* and its shaft are caused to rotate, and through the pitman L to impart a reciprocating motion to the sliding plate P^2, which carries the lower end of the cutter-slide bar *b* attached, as aforesaid, to the plate P^2 by the universal joint J. Thus the bar *b*, the screw S^2, and the cutter-slide M are made to oscillate automatically and radially from the pivot p^3 in the arm A, the amplitude of the oscillation of the cutter *c* being lessened as the said cutter is fed along toward the pivot p^3 or the center of the radial oscillation by the action of the screw S^2. The action of this screw is rendered automatic by the engagement of the spring-pawl *z* with the ratchet-wheel V once during each reciprocation of the sliding plate P^2, which partially rotates the said screw S^2 on its longitudinal axis. The required bevel, inclination, and taper of the teeth of the gear and the intervening spaces are by these means secured. A crown-wheel may be cut by lowering the arm A till its principal part is parallel with the bed B. A common spur-wheel may be cut by placing the cutter-spindle in the bearing r^2 in the cutter-slide M, adjusting the arm A^1 till it stands perpendicular to the bed, and setting fast the sliding plate P^2 after disconnecting the pitman L. By setting the sliding plate to give the required inclination of the bar *b* worm-gears may also be cut. In cutting spur and worm gears the cutter-slide M is not automatically fed along, but the screw S^2 is actuated by the hand-wheel *h*. I prefer to have the cutter-slide and cutter feed automatically from the circumference of the gear toward the central axis of the same, but it may, with nearly equal convenience, be actuated in a reversed manner, the only change necessary being the reversal of the positions of the pawl *z* and the ratchet-wheel V.

I claim—

In a gear-cutting machine, the rotating cutter *c*, having an automatic radial oscillating motion from the pivot p^3 as a center, and an automatic feed toward or from the central axis of the gear while the said gear is being cut, substantially as herein set forth.

In testimony whereof I hereunto sign my name in the presence of two subscribing witnesses.

CORD EDUARD JOHANNES GRUBE.

Witnesses:

OLAF WULFF,

H. SCHULZ.