2 Sheets--Sheet 1.

N. T. y MIRAPEIX.

Gear-Cutting Machines.

No. 152,400. Patented June 23, 1874.

Fig. 1.

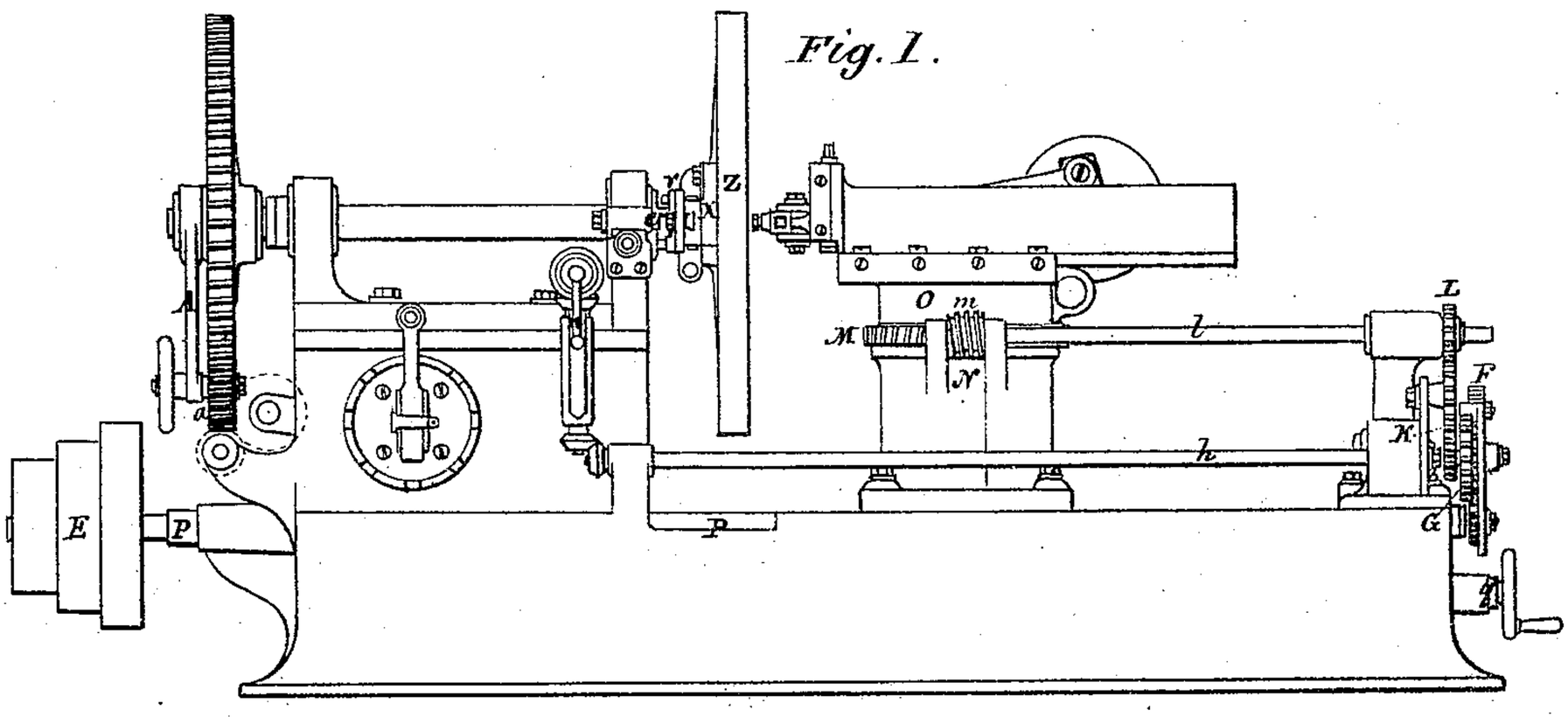


Fig. 3.

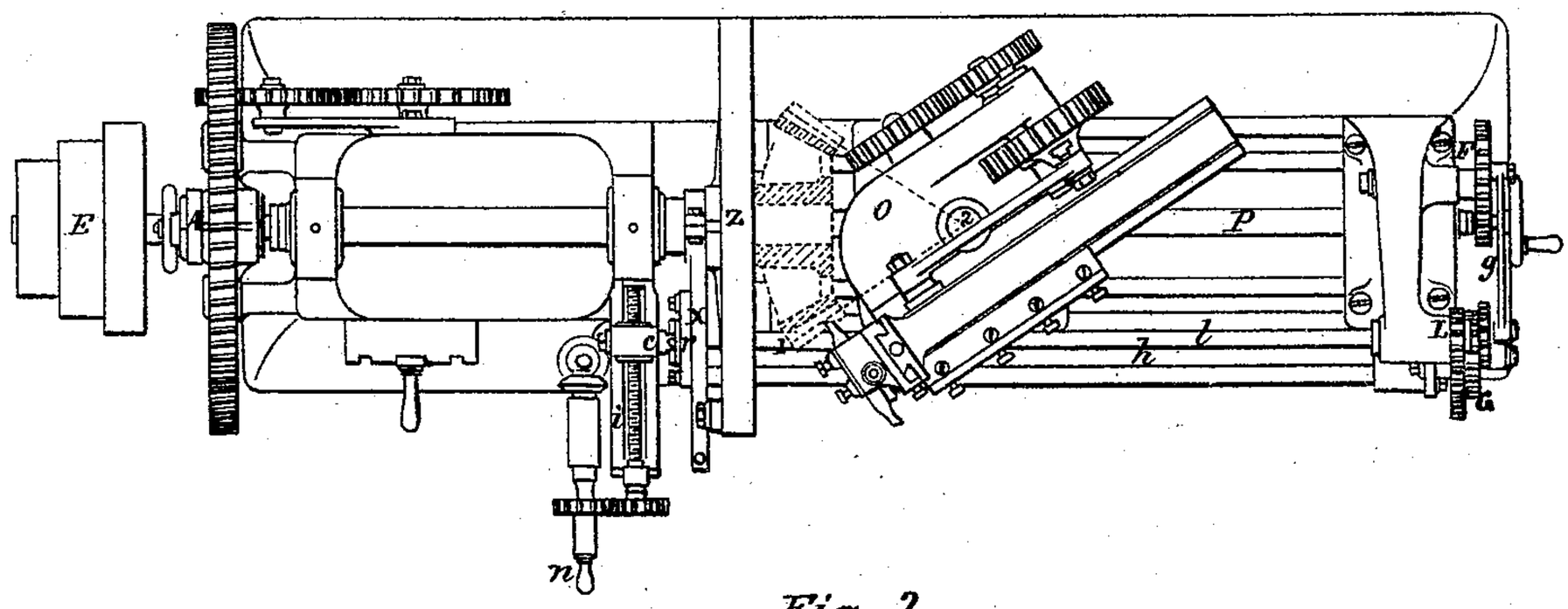
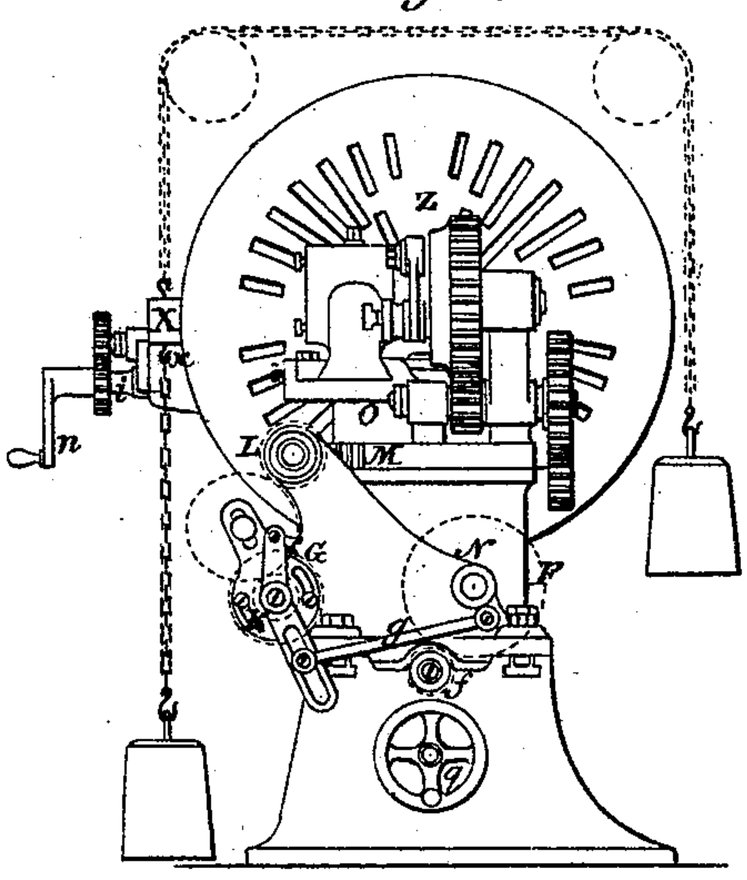


Fig. 2.



Witnesses.

Ewell A. Dick

Wm. C. Chaffee

Inventor

Nicolas Tous y Mirapeix

by atty Bowen

2 Sheets--Sheet 2.

N. T. y MIRAPEIX.

Gear-Cutting Machines.

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Fig. 6

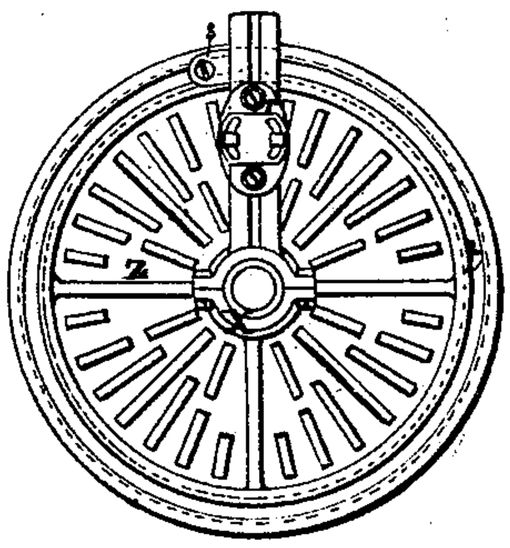


Fig. 5.

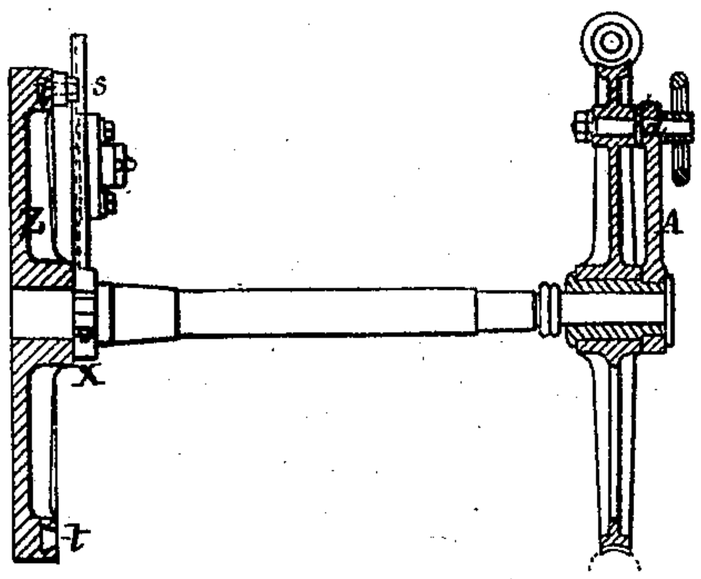


Fig. 4.

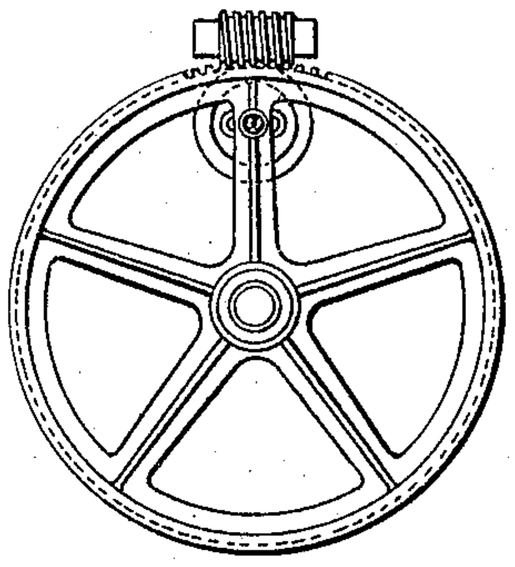


Fig. 7.

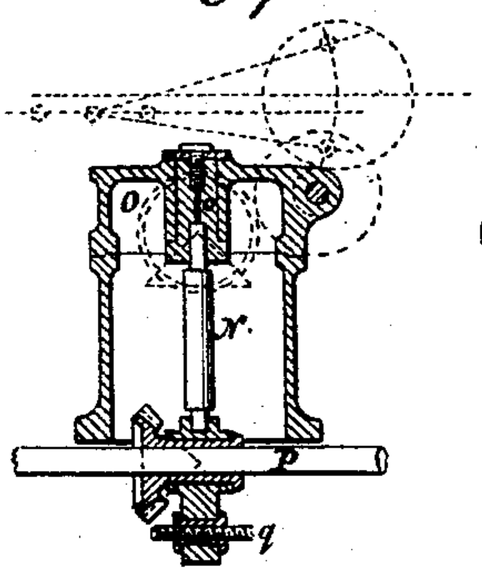


Fig. 8

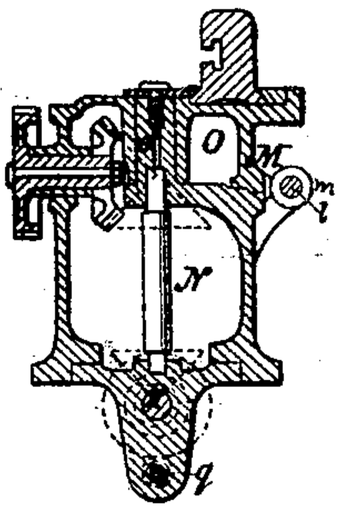


Fig. 9.

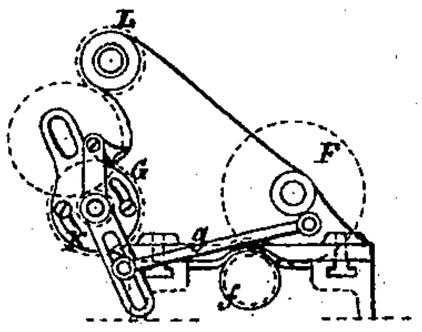
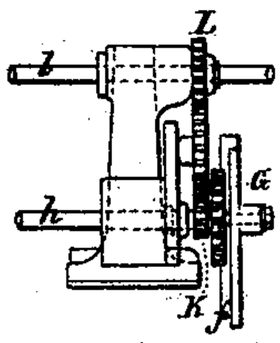


Fig. 10.



Witnesses.

Ewill A. Dick

Wm. E. Chaffee

Inventor.

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by atty N. Tolles

UNITED STATES PATENT OFFICE.

NICOLAS TOUS Y MIRAPEIX, OF BARCELONA, SPAIN.

IMPROVEMENT IN GEAR-CUTTING MACHINES.

Specification forming part of Letters Patent No. **152,400**, dated June 23, 1874; application filed May 1, 1874.

To all whom it may concern:

Be it known that I, NICOLAS TOUS Y MIRAPEIX, of Barcelona, Spain, have invented certain new and useful Improvements in Machines for Dividing, Tracing, and Planing the Teeth of Beveled Gear-Wheels, of which the following is a specification:

The machine in which my invention is comprised is designed for dividing, tracing, and planing the teeth of beveled gear-wheels.

The dividing movement or mechanism differs but little from that commonly used in gear-cutting machinery.

The tracing of the teeth is effected by two simultaneous movements, the one a movement of rotation on its axis of the wheel to be traced, the other a movement likewise of rotation of the tool around a point which is the apex of the cone of the wheel.

The movement of the tool is uniform, but not such as that of the wheel, for the latter is determined by the transverse movement of a steel point or stylet following a matrix or pattern of a form equal to the profile of the tooth to be traced.

In order to plane the surfaces of the teeth, I employ a pointed tool having a reciprocating movement in such manner that its successive trajectories shall be the radiuses of a circle, of which the center is the apex of the cone of the wheel.

Combining these two movements, there is generated a conical surface, which has for directrix the profile of the tooth, and for generatrix the path traversed by the tool.

To enable those skilled in the art to understand and use my invention, I shall now proceed to describe more particularly the manner in which the same is or may be carried into effect by reference to the accompanying drawings, in which—

Figure 1 is a side elevation, Fig. 2 is an end elevation, and Fig. 3 is a plan, of a machine embodying my improvements. Fig. 4 is an elevation of the dividing-wheel detached. Fig. 6 is a like view of the chuck or plate that holds the work. Fig. 5 is a side elevation of the axis or shaft on the opposite ends of which are mounted the dividing-wheel, and the work-holding chuck or plate, the two last-named parts being represented in section. Fig. 7 is a vertical section of the tool-carriage in the plane of the shaft *p*. Fig. 8 is a vertical central section of the same, in a plane at right angles to axis *p*. Fig. 9 is an end elevation, and Fig. 10 is a side elevation, of the head-gear for coupling the various movements.

As seen in the drawings, all portions of the machine are mounted on and carried by one and the same frame.

The machine is composed of three essential parts, viz: The mandrel, the head-gear for coupling the movements, and the tool-carriage.

The mandrel resembles, in the main, that found in ordinary lathes. On one end of its axis, outside of the dividing-wheel, is an arm, A, at the extremity of which is an oblong hole or slot traversed by a bolt, *a*, which connects it to one of the arms of the wheel, in such manner that when the hand wheel or nut on the bolt is tightened up, the dividing-wheel becomes rigidly united with the arm A, and consequently with the mandrel. When, on the other hand, the nut is unscrewed or loosened, the arm A may be actuated and moved, through the distance measured by the slot in its end, without causing any movement of the dividing-wheel. The disk or chuck head Z, is fixed on the mandrel. Behind said disk is another arm, X, which is loose on said mandrel, and carries the matrix or pattern which gives the profile of the tooth. The elliptical piece *r* that carries the pattern can be set in any desired position on the arm, so that the distance of the matrix from the axis of the mandrel shall be equal to the radius of the wheel to be cut or planed. The arm X carries a bolt, *s*, provided with a tightening-nut, and having its head shaped to fit the dove-tailed groove *t* in the chuck-head. When the matrix is to be used to give the profile of the tooth, the bolt is tightened, and the arm X, and, consequently, the matrix, become one with the disk or chuck-head. When, on the contrary, after finishing one tooth, it is necessary to turn the wheel to bring it into position to cut the succeeding tooth, the bolt *s* is loosened, the matrix becomes thus independent of the disk or chuck head, which latter can then be turned without drawing with it the matrix. The matrix bears on a steel point

or stylet, *c*, to which a transverse movement is imparted. In order that the matrix shall bear constantly on the stylet, I connect with the arm X a weight, either suspended directly from the hook *x* or attached to the upper side of the arm, and passing over pulleys, as indicated in dotted lines, according to the direction in which it is required to act. Movement is communicated to the various parts of the machine by means of a driving-shaft, P, which extends from end to end of the machine, and is provided with a cone of driving-pulley E. At the end of the driving-shaft, opposite to that on which the pulleys E are mounted, is a pinion, *f*, which engages a spur-wheel, F. The wheel last named transmits, by means of a connecting-rod, *g*, movement to a vibratory pawl, loose on the axis of a ratchet-wheel, G, fixed on the end of a shaft, *h*, which wheel, actuated intermittently by the pawl, imparts movement through gearing, as seen, to the screw-rod *i*, by means of which rod the transverse movement of the stylet is obtained, the said stylet being carried by a nut mounted on said screw-rod. Behind the ratchet-wheel G is a spur-wheel, K, fixed on shaft *h*, and which communicates intermittent movement to a wheel, L, that rotates shaft *l*. This shaft carries on its end a worm, *m*, that gears with the segment M of a helicoidal wheel fixed to the upper part of the tool-carriage. It is from the combined movements of the axes *l* and *h* that the result I have in view is in the main attained.

One condition of the combination is that the feed of the screw *i* shall equal that of the worm *m*, in order that during the time occupied by the index or stylet, in traversing the profile of the matrix, the tool shall work down from the outer end to the bottom of the tooth; but since the generatrices 1 2 of the wheel to be planed are different for each wheel, it is necessary to have the wheel L of different sizes to suit the circumstances of the case, the rule being that the number of its teeth shall equal the number of centimeters in the generatrix 1 2. If the latter are not exact in number the profile of the matrix would be made following a conic section, of which the generatrix corresponds to the exact length in centimeters. Care should also be taken to have the radius of the helicoidal wheel M an exact number of centimeters in length, and to give to the wheel K as many teeth as there are centimeters in the radius of wheel M. When the machine is thus arranged, the tool will take the same time to travel from top to the bottom of the tooth that the stylet requires to traverse the whole face of the matrix.

The tool-carriage is composed of two parts, the one, N, which, so long as the machine is in operation, is fixed or stationary, the other, O, which is turned by means of wheel M around an axis, *o*, on part N. On the movable part O is the tool-carrier, to which a reciprocating movement is imparted from the shaft P by means of beveled gearing, as indicated in Figs. 7 and 8. The upper beveled gear is mounted on and moves with the movable part O, and on the axis of said gear is mounted a spur-wheel, from which motion is imparted to the sliding tool-carrier by spur and crank wheels and connecting-rod, as customary in ordinary shaping-machines.

The longitudinal adjustment of the tool-carriage is obtained by means of the screw *q*, this adjustment, as before stated, being for the purpose of bringing the axis *o* to the summit or apex of the cone formed by the generatrices of the wheel to be cut.

The machine is operated as follows: The wheel to be cut being fixed on the chuck-head or disk Z, the matrix is placed on the arm X at a distance from the axis of the mandrel equal to the radius of the primitive circle on which the profile of the tooth should be traced. The wheels of the dividing mechanism and the head-gear being arranged to correspond to the number of teeth and the length of the generatrix 1 2 of the cone of the wheel, the center *o* of the tool-carriage is, by means of the adjusting-screw *q*, brought to the summit or apex of the cone. The tool is then adjusted, so that its point shall be in the same horizontal plane as the axis of the cone, and its line of reciprocating movement shall pass through the summit or apex of said cone. The machine being thus prepared, the upper or lower face of the tooth is presented to the tool, the bolt *a* is loosened, and the bolt *s* is tightened, and the mandrel is thus independent of the dividing-wheel. The machine is then put in motion, and the tool begins its work, tracing the generatrices of the conical surface, while the matrix presents the profile of the tooth, until the tool reaches the bottom of the tooth, and then the tool is withdrawn by means of the crank-handle *n*, which produces the same effect, and in the same time, on the index of the matrix. The face of one tooth is thus completed. In order to cut the next, the bolt *a* is tightened, the bolt *s* is loosened, and thus the mandrel is connected with the dividing-wheel and independently of the arm X. Then, by means of the dividing-wheel, the mandrel is turned a distance equal to one tooth, and when the work is brought to the proper position, the bolt *a* is loosened, the bolt *s* is tightened, and the operation is proceeded with as before. All the teeth being thus finished on one side, the positions of the matrix and stylet are reversed, so as to bring the index underneath, and the weight on the arm X is correspondingly shifted so as to press the matrix, as before, against the stylet. The tool is then adjusted in order to cut the new faces, and the operation is continued as above described.

Having now described my invention, and the manner in which the same is or may be carried into effect, what I claim, and desire to secure by Letters Patent, is—

In machinery for cutting the teeth of bev-

eled gear-wheels, the combination with the rotary chuck-head or disk for carrying and presenting the wheel to be cut, and the matrix or templet and stylet for imparting to said chuck-head an oscillating movement, following the profile of the tooth to be formed, of the reciprocating cutting-tool, and the tool-carriage rotary on an axis, adapted to correspond to the apex of the cone of the beveled gear-wheel to be cut, all combined and operating together, as herein shown and set forth.

In testimony whereof I have signed my name to this specification before two subscribing witnesses.

N. TOUS Y MIRAPEIX.

Witnesses:

ERNESTO FOUS,

DIEGO SERRA.