No. 645,428. Patented Mar. 13, 1900.

E. POLANOWSKI.

MACHINE FOR MILLING ANGULAR TOOTHED BEVEL WHEELS.

(Application filed May 11, 1898.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

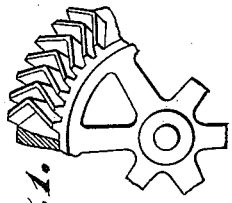
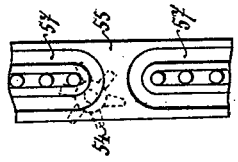


Fig. 2.

Fig. 3.



WITNESSES

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Fig. 4.

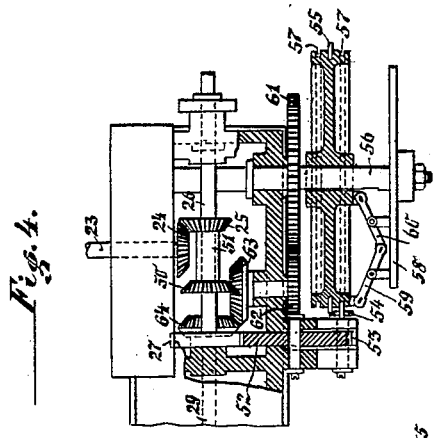
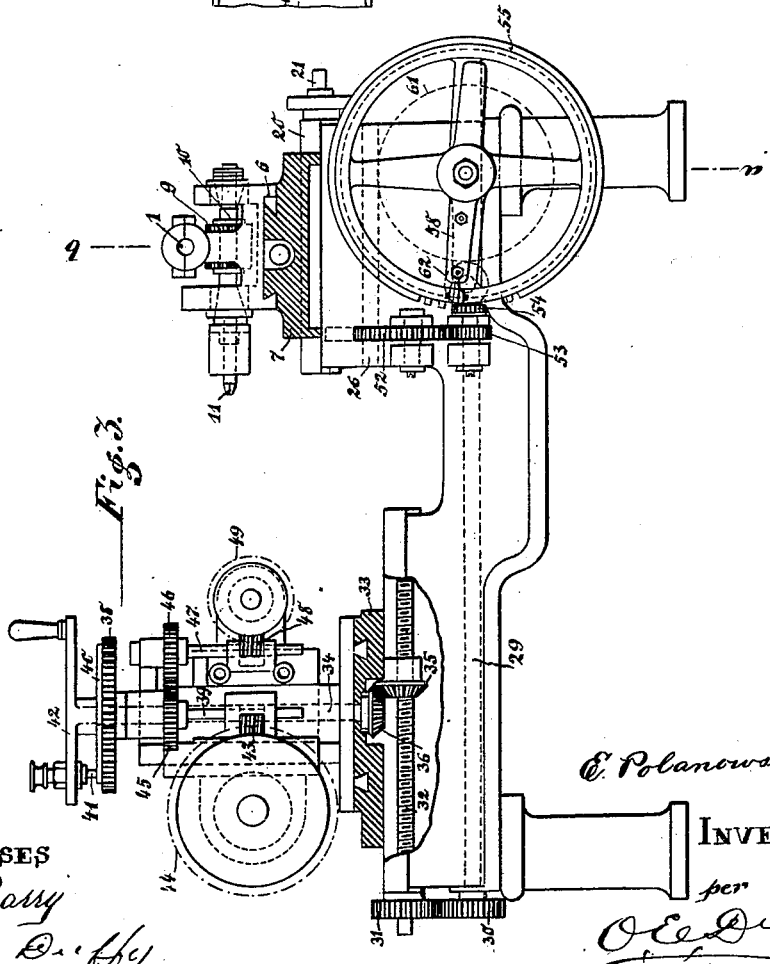


Fig. 3.



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EUZEBIUSZ POLANOWSKI, OF LODZ, RUSSIA.

MACHINE FOR MILLING ANGULAR-TOOTHED BEVEL-WHEELS.

SPECIFICATION forming part of Letters Patent No. 645,428, dated March 13, 1900.

Application filed May 11, 1898. Serial No. 680,414. (No model.)

To all whom it may concern:

Be it known that I, EUZEBIUSZ POLANOWSKI, a subject of the Emperor of Russia, residing in Lodz, Russia, have invented certain new and useful Improvements in Machines for Milling Angular-Toothed Bevel-Wheels, (patented in the following countries: England, No. 7,819, April 1, 1898; Austria, No. 48/3,039, May 28, 1898; Hungary, No. 12,590, April 1, 1898; Belgium, No. 134,703, March 29, 1898; France, certificat d'addition au brevet, No. 268,650, March 29, 1898; Switzerland, No. 16,768, April 9, 1898, and Italy, Reg. Att., Vol. 96, No. 31, April 9, 1898,) of which the following is a specification.

This invention relates to a machine which has for its object to mill out the periphery of conical disks in such a manner as to produce cone-wheels or bevel-wheels with angular teeth—that is to say, bevel-wheels having sagittal teeth. The machine can also be employed for finishing (by milling) cast angular-toothed bevel-wheels. In this machine the cone-disk or bevel-wheel to be treated and which rotates during the milling is cut out by a rectilinearly-moving milling-tool, the rotary axis of which is situated in the same plane as the axis of the bevel-disk and in which plane both axes form an acute angle with each other.

So far as described in the preceding paragraph the machine embodying my invention coincides with a machine for milling cone screw-wheels. From this elder machine the machine forming the subject of this invention differs inasmuch as it is provided with a self-acting returning motion or reversing-gear in such a manner that the bevel-disk to be milled makes during the milling of each tooth, first, a forward rotation up to the middle of the tooth to be cut, and then while the milling-tool continues to move in the same direction the bevel-disk moves back again until the milling-cutter has left the bevel-disk. During the return of the milling-tool the bevel-disk is moved in the reverse way.

In the accompanying drawings, Figure 1 illustrates in perspective a piece of an angular-toothed bevel-wheel, while the other figures illustrate a form of construction of the improved machine. Fig. 2 is a longitudinal section on the line *a b* of Fig. 3. Fig. 3 is a view in sectional elevation looking from left to right of Fig. 2. Fig. 4 is a sectional plane of the end to be seen from the right hand of Fig. 3. Fig. 5 shows a piece of the reversing-gear or returning motion.

The part of the machine shown in Fig. 2 contains at the top a horizontal shaft 1, which carries on its left-hand end the loose-stepped driving-pulley 2. The shaft 1 extends through the two bearing-standards 5 of a support 6, which is movable on the bed 7 in the direction of the length of the latter. Between the bearing-standards 5 there is mounted on the shaft 1 a screw-wheel 8, which shares the rotation of this shaft and also the movement of the support 6. This screw-wheel engages with a second screw-wheel 9, which is mounted at right angles to the first-mentioned wheel, also in the support 6 on the shaft 10 of the milling-cutter 11, (Fig. 3, right-hand end,) and causes this cutter to rotate. A spur-wheel 12, mounted on the right-hand end, Fig. 2, on the shaft 1, drives, by means of the gear 13 14 15, a screw-spindle 19, and through the latter moves the support 6 along its bed 7. The above-mentioned gear is arranged in the same manner as in screw-cutting lathes—that is to say, so that the direction of the motion of the support 6 can be reversed. The bed 7 of the support 6 is capable of being moved transversely to the direction of its length along a second bed 20, Fig. 3, by means of the screw-spindle 21. A spur-wheel 18 on the screw-spindle 19, Fig. 2, rotates a spur-wheel 22, which is situated under it and whose shaft 23 carries on its other end a bevel-wheel 24, which engages with the bevel-wheel 25 on the shaft 26.

The parts described till now exist altogether in a machine for milling cone screw-wheels.

In the machine embodying my invention the bevel 25, Fig. 4, is mounted, with a second bevel-wheel 50, on a sleeve 51, which is capable of moving along the shaft 26, but is also capable of rotating therewith. On imparting rearward motion to the slide 6, Fig. 3, which carries the milling-cutter, the sleeve 51, together with the bevel-wheels 25 and 50, is moved so that the bevel-wheel 50 comes into gear with the bevel-wheel 24. In consequence

the shaft 26 rotates always in the same direction during the to-and-fro movement of the milling-tool.

The rotation of the shaft 26, Figs. 2 and 4, is transmitted, by means of the spur-wheel 27, mounted thereon, through the medium of the intermediate spur-wheel 52, to the spur-wheel 53. Upon one end of the shaft of the latter there is keyed a star-wheel 54. The star-wheel 54 gears with its teeth in a pin-wheel 55, which is mounted so as to be capable of shifting along its shaft 56 and which carries the latter shaft 56 around with it in its rotation by means of a feather. The pin-wheel 55 is provided on each side of its row of pins along its periphery with a groove 57, and these two grooves return into each other at two adjacent places on the pin-wheel, (see Fig. 5,) so that both grooves form a continuous groove with two turning-points.

In the groove 57 there engages the end of the shaft that carries the star-wheel 54 in such a manner that when this end reaches one or the other turning-point of the groove 57 the star-wheel 54, which is continually rotating in the same direction, will impart a reverse rotation to the pin-wheel 55. On entering one of the turning-points of the groove 57 the shaft on the star-wheel 54 moves the pin-wheel 55 parallelly to its shaft 56, and in order that this shall take place uniformly there are arranged on an arm 58, fixed on the shaft 56, two levers 59 and 60, Fig. 4, which are connected together and of which one engages at the periphery and the other at the hub of the pin-wheel 55. The pin-wheel 55 therefore makes alternately one rotation in one direction and one rotation in the other direction.

The rotary motions of the pin-wheel 55 are transmitted by the spur-wheels 61 and 62 to a bevel-wheel 63, which in turn moves the bevel-wheel 64 of the shaft 29. The shaft 29, Fig. 3, transmits its motion to parts which exist in a machine for milling cone screw-wheels. The said shaft 29 rotates, by means of the exchangeable spur-wheels 30 and 31, a screw-spindle 32. This spindle can move another support 33 along its bed. Through the center of this support there extends a vertical shaft 34, which receives rotation from below from the spindle 32 by means of the bevel-gearing 35 36. The bevel-wheel 35 has internal screw-thread, and it is coupled with the spindle 32 by means of a wedge when the support 33 has been brought in the proper position. At its upper end the shaft 34 carries a horizontal spur-wheel, (not visible in the drawings,) and this wheel gears in a larger spur-wheel 38, which is mounted loose upon a shaft 39, that is parallel to the shaft 34. The wheel 38 carries on its upper face a dividing-disk 40, provided with concentric rows of holes and serving, as known in machines for milling wheels, the purpose to appoint the required number of teeth. The dividing-disk 40 being fixed to the wheel 38 is coupled, by means of the removable pin 41, which is inserted in one of the holes of the row of holes corresponding with the desired number of teeth, with a crank 42, which is fixed to the shaft 39. Below there is mounted on the shaft 39 a worm 43, which gears with a worm-wheel 44, to which the cone-disk to be machined is fixed. The shaft 39 drives, by means of the spur-wheels 45 46, a second shaft 47, which is parallel to it and which moves, by means of a worm 48, a smaller worm-wheel 49. This latter serves to receive cone-disks of small sizes.

Both the worm-gears 43 44 and 48 49 are adjustable vertically in order to be able to adjust them with regard to the cutter in such a manner that the axes of the worm-wheels 44 and 49 are situated in the same plane as the axis of the cutter. Moreover, both the said worm-gears are capable of rotating with the whole wheel-gear (driven by the shaft 34) upon the base-plate of the support 33 about the shaft 34, so that the cone-disk to be machined can be set at the proper angle to the milling-cutter.

In the machine embodying my invention and differing, as above stated, from the elder machine by being provided with the self-acting returning motion or reversing-gear the ratios of gearing of the wheels which operate the pin-wheel 55 are so chosen that the pin-wheel during one travel of the cutting-tool will rotate the bevel-wheel to be cut first in a forward direction until the milling-tool has reached approximately the middle of the bevel-surface and will then move it back again in the manner which is required to form the angular or double helical teeth.

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

1. In a machine for milling bevel-wheels with angular teeth the combination of means carrying the cone-disk to be cut, a cutter rotatable about its longitudinal axis and movable in the direction of its axis at right angles to it and means of rotating the said cutter, of moving it at right angles to its longitudinal axis and of imparting a slow partial rotation to the said worm-wheel first in one direction, until the said cutter has reached the middle of the bevel-surface of the cone-disk, and then in the other direction, comprising a star-wheel 54 rotating always in the same direction and a pin-wheel 55 which gears with the said star-wheel, is capable of shifting along its shaft 56 and is provided on each side of its row of pins along its periphery with a groove 57, these two grooves returning into each other at two adjacent places on the pin-wheel, thus forming a continuous groove with two turning-points, in which groove engages the end of the shaft, that carries the star-wheel 54 substantially as described.

2. In a machine for milling bevel-wheels with angular teeth the combination of means carrying the cone-disk to be cut, a cutter rotatable about its longitudinal axis and movable in the direction of its axis at right an-

gles to it, means of adjusting the said cutter in the direction of its longitudinal axis and means of rotating the said cutter, of moving it at right angles to its longitudinal axis and of imparting a slow partial rotation to the said worm-wheel first in one direction until the said cutter has reached the middle of the bevel-surface of the cone-disk, and then in the other direction, comprising a star-wheel 54 rotating always in the same direction and a pin-wheel 55 which gears with the said star-wheel, is capable of shifting along its shaft 56 and is provided on each side of its row of pins along its periphery with a groove 57, these two grooves returning into each other at two adjacent places on the pin-wheel, thus forming a continuous groove with two turning-points, in which groove engages the end of the shaft, that carries the star-wheel 54, substantially as described.

3. In a machine for milling bevel-wheels with angular teeth the combination of means carrying the cone-disk to be cut, a cutter rotatable about its longitudinal axis and movable in the direction of its axis at right angles to it, means of adjusting the said cutter in the direction of its longitudinal axis, means of adjusting the said worm-wheel with regard to the said cutter and means of rotating the said cutter, of moving it at right angles to its longitudinal axis and of imparting a slow partial rotation to the said worm-wheel first in one direction, until the said cutter has reached the middle of the bevel-surface of the cone-disk, and then in the other direction, comprising a star-wheel 54 rotating always in the same direction and a pin-wheel 55 which gears with the said star-wheel, is capable of shifting along its shaft 56 and is provided on each side of its row of pins along its periphery with a groove 57, these two grooves returning into each other at two adjacent places on the pin-wheel, thus forming a continuous groove with two turning-points, in which groove engages the end of the shaft, that carries the star-wheel 54, substantially as described.

4. In a machine for milling bevel-wheels with angular teeth the combination of means carrying the cone-disk to be cut, a cutter rotatable about its longitudinal axis and movable in the direction of its axis at right angles to it, means of rotating the said cutter, of moving it at right angles to its longitudinal axis and of imparting a slow partial rotation to the said worm-wheel first in one direction, until the said cutter has reached the middle of the bevel-surface of the cone-disk, and then in the other direction, comprising a star-wheel 54 rotating always in the same direction, a pin-wheel 55, which gears with the said star-wheel, is capable of shifting along its shaft 56 and is provided on each side of its row of pins along its periphery with a groove 57, these two grooves returning into each other at two adjacent places on the pin-wheel, an arm 58 fixed on the shaft 56, and two levers 59 and 60, which are connected together and of which one engages at the periphery, and the other at the hub of the pin-wheel 55, substantially as described.

Signed at Warsaw, Poland, this 25th day of April, 1898.

EUZEBIUSZ POLANOWSKI.

Witnesses:

HEINRICH MARKERT,

ADOLF JAHN.