A. KINGSBURY.

GEAR CUTTING MACHINE.

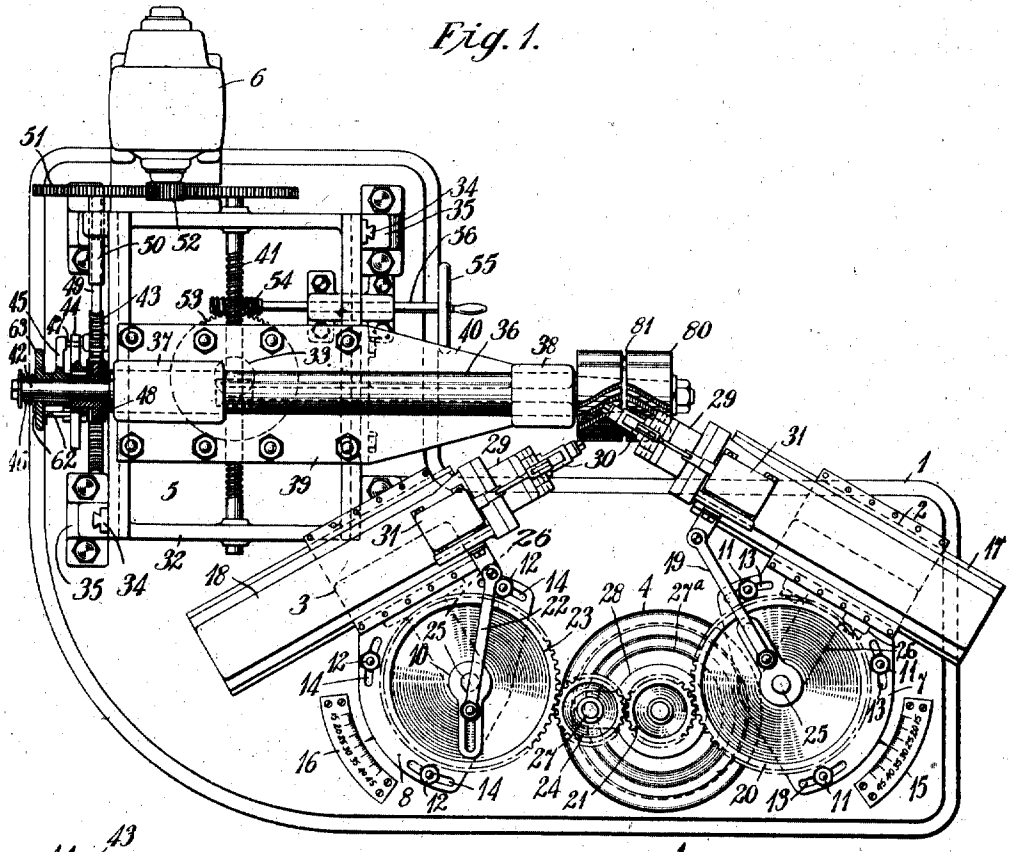
APPLICATION FILED OCT. 23, 1912.

1,250,320.

Patented Dec. 18, 1917.

2 SHEETS—SHEET 1.

Fig. 1.



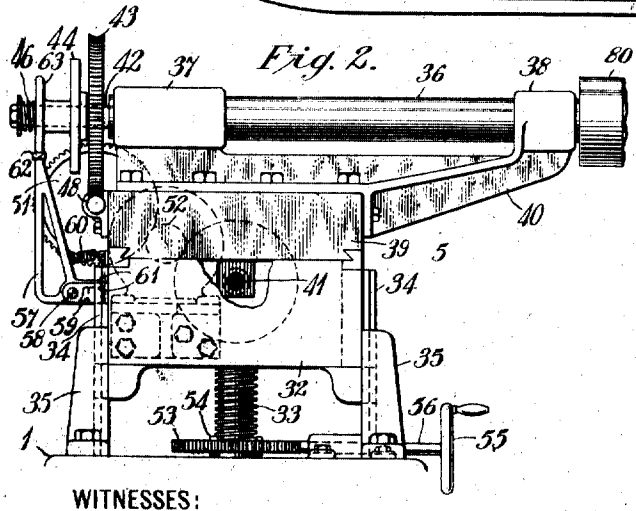


Fig. 2.

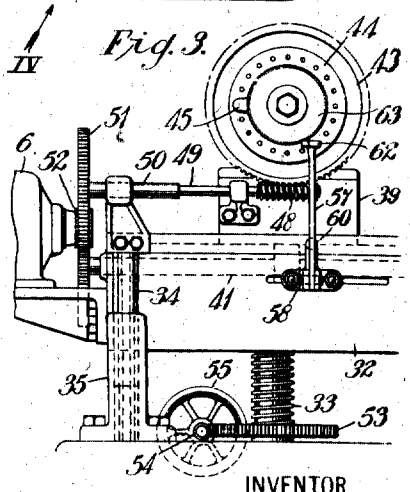


Fig. 3.

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2 SHEETS—SHEET 2.

Fig. 4.

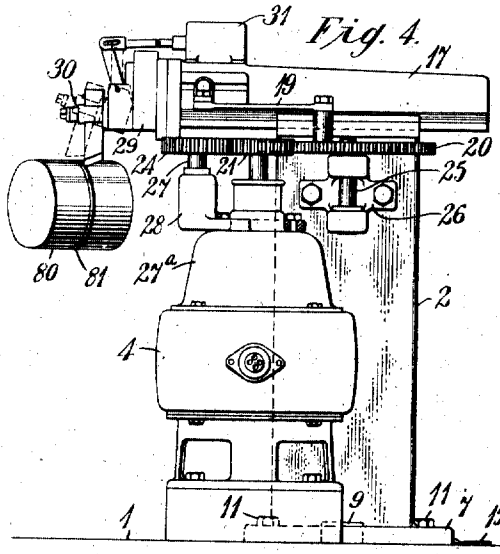


Fig. 5.

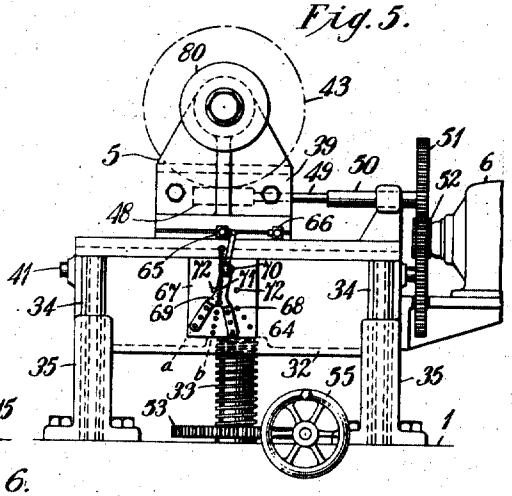


Fig. 6.

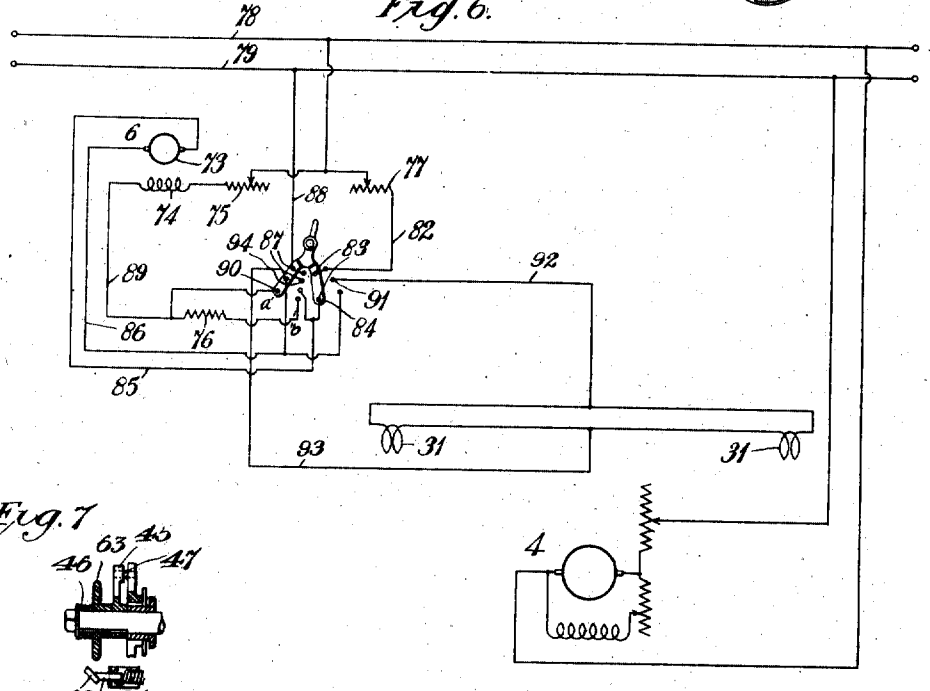


Fig. 7

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GEAR-CUTTING MACHINE.

1,250,320. Specification of Letters Patent. Patented Dec. 18, 1917.

Application filed October 23, 1912. Serial No. 727,394.

To all whom it may concern:

Be it known that I, ALBERT KINGSBURY, a citizen of the United States, and a resident of Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Gear-Cutting Machines, of which the following is a specification.

My invention relates to gear-cutting machines, and it has special reference to such machines as are adapted to cut double helical or herring-bone gears.

The object of my invention is to provide an automatic machine of the class above indicated that shall be adapted to cut herring-bone gears having relatively narrow slots between their right-hand and left-hand teeth, with a relatively small loss of material.

The advantages secured by the use of double-helical or herring-bone gears are well understood, the fact that they are difficult and relatively expensive to manufacture being the principal reason why they have not hitherto been more extensively utilized.

According to my present invention, I provide an automatic machine comprising a pair of cutting tools which have straight line reciprocatory movements and means for so adjusting and feeding a gear blank as to cut a herring-bone gear having true involute teeth.

Figure 1, of the accompanying drawings, is a plan view of an automatic machine constructed in accordance with my invention. Figs. 2 and 3 are elevations, at right angles to each other, of the work-supporting member, and Fig. 4 is a view looking in the direction of the arrow 4 of Fig. 1, showing the driving motor and one of the shapers which form parts of the machine. Fig. 5 is an elevation of the work-supporting member from the side opposite to that of Fig. 3, Fig. 6 is a diagrammatic view showing the circuit connections for the driving and feed motors and the tool magnets of the machine, and Fig. 7 is a detail plan view showing the relation between certain of the operating parts of the machine.

Referring to Figs. 1 to 5, inclusive, of the drawings, the machine here shown comprises a bed plate 1, a pair of shaper pedestals 2 and 3, a driving motor 4, a work-supporting member 5 and a feed motor 6.

The pedestals 2 and 3 have enlargements or base projections 7 and 8 and are pivotally mounted about centers 9 and 10, being secured to the bed plate 1 by bolts 11 and 12 which extend through circumferential slots 13 and 14 in the base projections. The arrangement of parts is such that the bolts may be loosened, the shaper pedestals adjusted to any desired angle, as indicated by protractor dials 15 and 16, and clamped in position by tightening the bolts.

Two carriages 17 and 18 are adjustably supported upon the pedestals 2 and 3 and are reciprocated by the motor 4 to which they are respectively connected, on the one hand, by a connecting rod 19 and a combined gear wheel and crank-head 20 which meshes with a motor pinion 21 and, on the other hand, by a connecting rod 22, a combined gear wheel and crank-head 23 and an idler gear wheel 24 interposed between the gear wheel 23 and the pinion 21.

The arrangement of parts is such that the motor drives the gear wheels 20 and 23, at the same speed in opposite directions.

The connections between the rods 19 and 22, and their respective crank-heads are adjustable so that the extent of travel of the tool carriages may be adjusted in a well known manner.

The shaper pedestals are respectively provided with brackets 26 by which the gear wheels 20 and 23 and their counter-shafts 25 are rotatively supported, the extended center lines of the shafts passing through the pivotal points 9 and 10.

An end frame 27ª of the motor 4 is provided with a bracket 28 by which the idler gear wheel 24 and its shaft 27 are rotatively supported.

The arrangement of parts is such that either or both of the shaper pedestals may be angularly adjusted without interfering with the driving connections above described.

Each of the shaper carriages 17 and 18 is provided with a vertically adjustable shaper head 29, to which a tool holder 30 is pivotally secured, and with a magnet 31 for so tilting the tool holder as to lift the tool out of range of the work, while the gear blank is being backed to its initial position after each tooth slot is completed as hereinafter pointed out.

The crank heads 20 and 23 are so set relatively to each other that the shaper car-

riages alternate in their strokes. The angle of inclination of these carriages to the axial line of the gear determines the pitch of the spiral of the teeth to be cut. This angle may be adjusted over comparatively wide limits. The work-supporting member 5 comprises a bed 32, a spindle 36, which is rotatively supported in bearings 37 and 38, and a spindle carriage 39.

The bed 32 is supported on a vertical feed screw 33 and is provided with guide projections 34 which operate in suitably slotted guide brackets 35.

The spindle carriage 39 is provided with a bracket 40 carrying the spindle bearings 37 and 38 in which the spindle is rotatively supported.

The spindle carriage is transversely adjustable on the bed 32, its position being dependent upon a feed screw 41.

The spindle 36 is provided with a projection 42 constituting a dividing head spindle with which is associated indexing mechanism of any suitable type. As shown in the drawings, such indexing mechanism comprises a worm wheel 43, an index plate 44 which is secured to said worm wheel 43, and an index pawl 45. The worm wheel 43 is rotatively mounted on the projection 42, the index plate 44 being secured to, and forming a part of, the worm wheel, and the index pawl 45 is splined to the projection 42 and is backed by a spring 46, so that it may be moved longitudinally of the projection but is forced to turn with the spindle.

The spindle 36 is rotated when a pin projection 47 of the index pawl 45 engages a hole in the index plate 44, since an operative connection is thus established from the worm wheel 43 to the spindle. The worm wheel 43 is driven by a worm 48, which is mounted on an extensible shaft composed of a driven member 49 and a tubular driving member 50 operatively connected to the feed motor 6 by means of a gear wheel 51 and a motor pinion 52. The driven member of the shaft telescopes into the tubular driving member 50 in a well known manner, thereby permitting the necessary transverse adjustment of the spindle carriage 32.

The vertical feed screw 33 on which the carriage 32 is mounted, is provided with a worm wheel 53 which meshes with a worm 54, a hand wheel 55 being secured to the opposite end of a shaft 56 from the worm 54 and adapted, when operated, to turn the feed screw 33.

A knock-out lever 57 is pivotally supported at 58 on a projection 59 of the bed 32 and is held in the position in which it is shown in Fig. 2 of the drawings, by a spring 60, so that it is free to move in one direction, in opposition to the spring, but is prevented by cooperating stop projections 61 from moving farther in the opposite direction.

The upper end of the lever is provided with surfaces 62 which are inclined relative to the travel of the spindle carriage 39 and are adapted to be engaged by a flange 63 of the pawl 45 at predetermined points in the travel of the spindle carriage. The arrangement of parts is clearly shown in Fig. 7, and is such that, when the spindle carriage travels away from the feed motor 6, and toward the knockout lever 57, the knock-out lever is merely pushed aside by the flange 63, but, when the spindle carriage is moving in the opposite direction, the engagement between the flange 63 and the knock-out lever forces the pawl 45 outward, in opposition to the spring 46, thereby releasing the pin projection 47 from the index plate 44 and permitting the gear wheel 53 and the index plate to be rotatively moved independently of the spindle until the pin projection 47 falls into the next hole in the index plate.

Any other suitable automatic indexing arrangement may, of course, be employed within the spirit and scope of my invention.

As shown in Fig. 5 of the drawings, an automatic control switch 64 is mounted on the spindle bed 32 and is actuated at predetermined limits in the travel of the spindle carriage 39 by adjustable stops 65 and 66. The switch comprises an insulating face plate 67 having a plurality of stationary contact members 68 secured to its surface, and a movable contact member 69 which is pivotally supported at 70 and is constrained, by means of a spring 71, to occupy the one or the other of two positions *a* and *b*. The switch positions are determined by stops 72.

Referring to Fig. 6 of the drawings, the feed motor 6 comprises an armature 73 and a field magnet winding 74, and is provided with field-regulating resistors 75 and 76 and an armature resistor 77.

The motors 4 and 6 are supplied with energy, from any suitable source, through line conductors 78 and 79.

The operation of the machine is as follows:—

Assuming that a gear blank 80 is firmly supported at the end of the spindle 36 and has a suitable slot 81 cut in its cylindrical surface to separate the two parts of the gear; that the spindle carriage is adjusted to such position that the cutting tools may operate without interfering with the gear blank, and that the gear blank is so mounted on the spindle that the shaper tools travel to the central plane of the slot, if the spindle carriage and bed are adjusted vertically until the shaper tools are working in a horizontal plane corresponding to the bottom of the desired tooth slots in the gear, the motor 4 may be started to set the tools in operation, and the motor 6 started to slowly feed the spindle carriage away from the feed motor 6.

The shaper tools, as they move in their working strokes inwardly toward the center or median slot 81 of the blank, will, of course, start to cut the gear blank at only two points which lie adjacent to the median slot. These initial cuts are evidently very short. However, as the operation continues and the spindle carriage progresses and the top of the spindle is rotated backwardly by means of the reduction gearing, the tools will gradually cut longer and deeper slots until slots of full depth extend the entire width of the blank.

The stop 66 is so placed as to actuate the movable switch arm 69 when the gear blank has so far progressed that the first tooth slot is complete, the arrangement of parts being such that the flange 63 of the index pawl has passed the knock-out lever 57.

When the stop 66 engages the upper end of the movable switch arm 69, it is thrown from the position *a* in which it is illustrated, to the position *b*.

In position *a*, the circuit connections for the feed motor are completed as follows: from conductor 78, through armature resistor 77, a conductor 82, a pair of contact members 83—which are bridged by one branch 84 of the movable switch arm—a conductor 85, the motor armature 73, a conductor 86, a pair of contact members 87—which are bridged by the opposite branch of the arm—and a conductor 88 to the line conductor 79. A field circuit is established from the conductor 78 through the field regulating resistor 75, the field magnet winding 74, a conductor 89, contact fingers 90 and 87 and the conductor 88 to the line conductor 79.

When the switch occupies its position *b*, the current traverses the motor armature 73 in the reverse direction, and the resistor 76 is introduced into the field circuit. Consequently, the motor is reversed and its speed is materially increased. Furthermore, a circuit is established from the conductor 82, through contact members 83 and 91, a conductor 92, the magnet coils 31, a conductor 93, contact members 94 and 87 and the conductor 88 to the line conductor 79. Thus, when the feed motor is reversed the magnets 31 are energized.

As hereinbefore pointed out, the magnets 31, when energized, raise the shaper tools sufficiently to clear the gear blank.

As the gear blank and the spindle carriage are moved rapidly toward the feed motor, the index pawl is tripped, as above indicated, and permits the pin projection 47 to move into the next hole in the index plate.

The holes in the index plate are so spaced as to produce the necessary rotative adjustment of the gear blank relative to the feed mechanism for properly spacing the tooth slots. It is therefore evident that, as the gear blank is moving toward the feed motor on the return stroke, a suitable indexing adjustment is automatically effected and, when the stop 65 engages the arm 69 of the control switch, the feed motor is again reversed, and the gear blank is slowly fed through another cutting stroke.

The structure shown in the drawings and set forth in the foregoing description may be variously modified by persons skilled in the art to which my invention relates, and its elements may be replaced by equivalent parts, without departing from the scope of my invention. It is therefore to be understood that my invention comprehends all such modifications and changes and is limited only by the scope of the appended claims.

I claim as my invention:

1. In a gear cutting machine, the combination with a rotary spindle to which a gear blank may be secured, of means for simultaneously imparting a transverse and rotative movement to the spindle, and cutting tools adapted to cut alternately from opposite sides of the blank toward the center.

2. In a gear cutting machine, the combination with a rotatable gear blank carrier, of means for imparting a transverse movement and a rotative movement to the carrier, and a pair of reciprocating cutting tools adapted to cut alternately from opposite sides of the blank toward its central plane.

3. In a gear-cutting machine, the combination with a rotatable gear blank carrier, and means for imparting a transverse movement and a rotative movement to the carrier, of a pair of reciprocating cutting tools adapted to cut alternately from opposite sides of the blank toward its central plane, and means for reversing both movements of the blank carrier at predetermined limits in the transverse movement thereof.

4. In a gear-cutting machine, the combination with a rotatable gear blank carrier, means for imparting a transverse movement and a rotative movement to the carrier, and a pair of reciprocating cutting tools adapted to cut alternately from opposite sides of the blank toward its central plane, of means for reversing both movements of the blank carrier at predetermined limits in the transverse movement thereof, and means for producing a rotative adjustment of the carrier during each return stroke.

5. In a gear-cutting machine, the combination with a rotary blank carrier, a feed screw for producing a transverse movement thereof, means operatively connected to the screw for simultaneously producing a rotative movement of the carrier, means for driving the feed screw alternately in opposite directions, and an automatic index mechanism for producing a rotative adjustment of the carrier during each return stroke of

the carrier, of a pair of reciprocating tools cutting alternately from opposite sides of the blank toward the center.

6. In a gear-cutting machine, the combination with a rotary blank carrier, a feed screw for producing a transverse movement thereof, means operatively connected to the screw for simultaneously producing a rotative movement of the carrier, and means for driving the feed screw alternately in opposite directions, of an automatic index mechanism for producing a rotative adjustment of the carrier during each return stroke of the carrier, a pair of reciprocating tools cutting alternately from opposite sides of the blank toward the center, and means for lifting the tools out of range of the gear blank during the entire return stroke of the carrier.

7. In a gear-cutting machine, the combination with a rotary blank carrier, a feed screw for producing a transverse movement thereof, means operatively connected to the screw for simultaneously producing a rotative movement of the carrier, and means for driving the feed screw alternately in opposite directions, of an automatic index mechanism for producing a rotative adjustment of the carrier during each return stroke of the carrier, a pair of shapers pivotally adjustable and having reciprocating cutting tools operating at an angle to each other in substantially the same plane, and means for operatively connecting the shapers, whereby they are adapted to cut alternately from opposite sides of the gear blank toward the central plane.

In testimony whereof, I have hereunto subscribed my name this 17th day of Oct., 1912.

ALBERT KINGSBURY.

Witnesses:
GOLDIE E. MCGEE,
B. B. HINES.