July 7, 1925. 1,545,111

A. L. WILDER

GEAR GRINDING MACHINE

Filed April 30, 1923 2 Sheets-Sheet 1

Fig. 1.

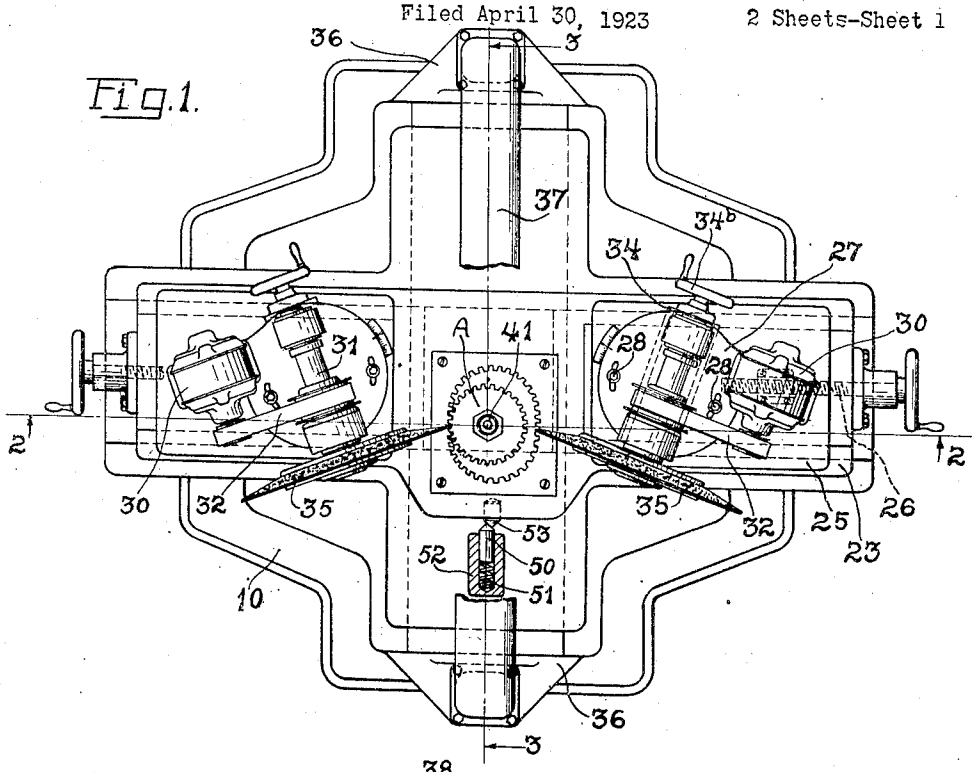

Fig. 2.

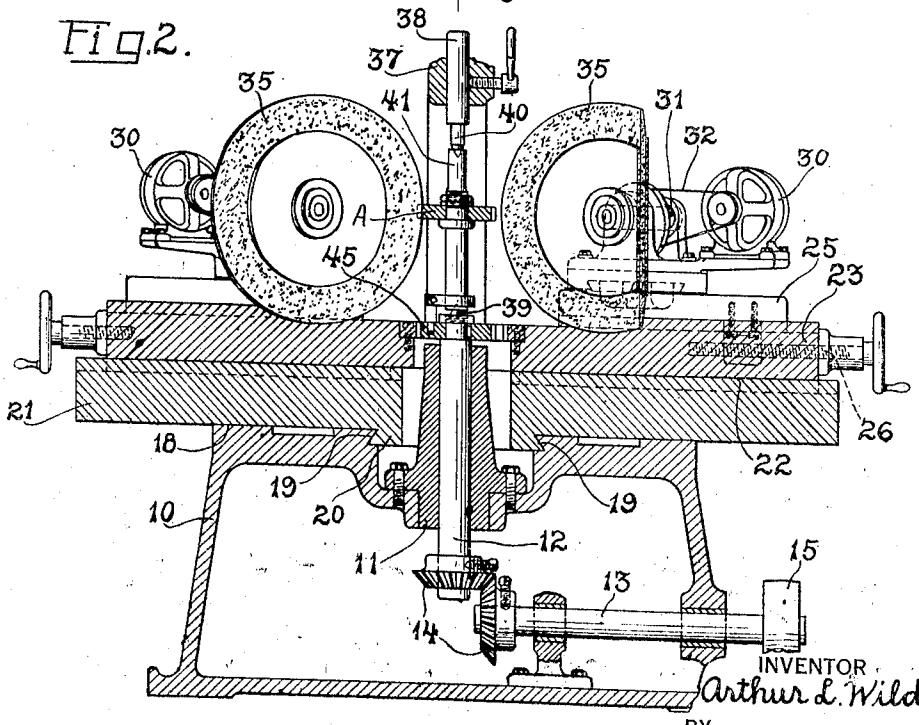

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Fig. 3.

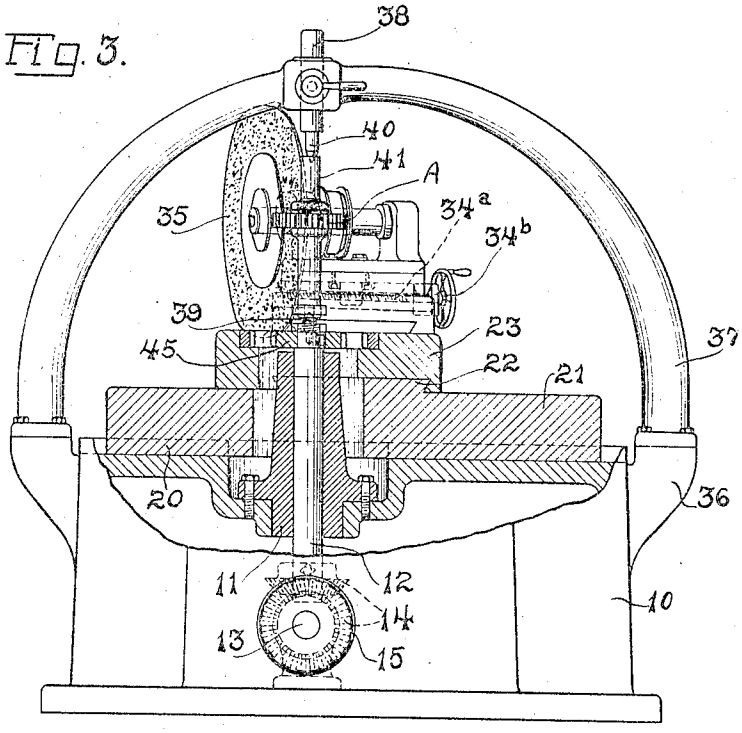
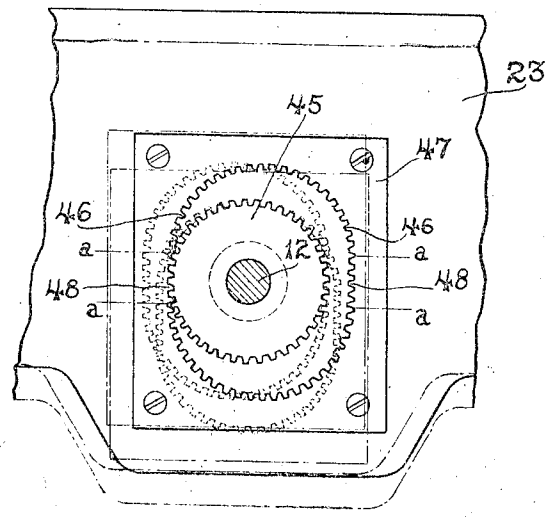


Fig. 4.



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Patented July 7, 1925. 1,545,111

UNITED STATES PATENT OFFICE.

ARTHUR L. WILDER, OF WETHERSFIELD, CONNECTICUT, ASSIGNOR TO PRATT & WHITNEY COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW JERSEY.

GEAR-GRINDING MACHINE.

Application filed April 30, 1923. Serial No. 635,593.

To all whom it may concern:

Be it known that I, ARTHUR L. WILDER, a citizen of the United States, residing at Wethersfield, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Gear-Grinding Machines, of which the following is a specification.

This invention relates to gear grinders and in particular to a grinder provided with two oppositely disposed grinding wheels adapted to engage opposite sides of different teeth.

An object of the present invention is to provide a construction of gear grinding machine enabling a large number of identical gears to be rapidly ground in a relatively simple form of machine. Another object of the invention is to provide a construction providing a wide range of adjustment of parts to adapt the machine for widely different types and sizes of gears.

Another object of the invention is to provide means for constantly rotating the work holding spindle and to provide means to actuate the abrasive wheels upon slides so that they will correctly engage successive teeth on the gear blank to generate involute tooth curves.

Another object of the invention is to provide special means for guiding the movements of the wheels, these means being in the form of slides disposed to move at right angles to each other, one of the slides preferably being superposed upon the other. These slides are actuated to move the wheels by engagement of a master gear on the work spindle with the toothed periphery of an elongated opening mounted in one of the slides.

Another object of the invention is to provide a machine operating upon the same general principle defined in the application of H. D. Tanner, Serial No. 544,176, filed March 16th, 1922.

With these and other objects in view, my invention consists in the features of construction and operation set forth in the following specification and illustrated in the accompanying drawings.

In the accompanying drawings annexed hereto and forming a part of this specification, I have shown my invention embodied in a grinding machine for spur gears but it will be understood that certain features of the invention may be otherwise embodied, or adapted for gears of other types, and that the drawings are not to be construed as defining or limiting the scope of this invention, the claims appended to this specification being relied upon for that purpose.

In the drawings:

Figure 1 is a plan view of the complete machine.

Fig. 2 is a vertical sectional view taken on line 2—2 of Fig. 1.

Fig. 3 is a vertical sectional view taken at right angles to Fig. 2.

Fig. 4 is a plan view of the parts controlling the movements of the wheel mounting slides.

In the above mentioned drawings, I have shown but one modification of the invention which is now deemed preferable but it is to be understood that changes and modifications may be made within the scope of the appended claims to adapt the mechanism for other types or sizes of gears without departing from the spirit of the invention.

Briefly, my invention in its broadest aspect comprises the following principal parts: first, a base; second, a vertically supported rotatable spindle; third, a master gear thereon; fourth, means on the spindle adapted to support and rotate a work arbor; fifth, a large horizontally disposed slide mounted upon ways so that it may be moved forward and rearward; sixth, another slide mounted to move upon and at right angles to the first slide; and seventh, independently adjustable slides carrying the wheel heads each being provided with a rotatable wheel spindle and an abrasive wheel and driving means therefor.

Referring more in detail to the figures of the drawings, I provide a base 10 having, approximately in the center thereof, a vertically disposed support 11 rigidly secured to the base 10 and providing a bearing for a rotatable spindle or shaft 12. This spindle 12 is adapted to be continuously rotated by any convenient means such as by the shaft 13 within the base 10 connected to such spindle by bevel gears 14. The shaft 13 may be rotated by a suitable pulley 15 or by any other suitable power means.

On the upper horizontal surface 18 of the base are provided ways 19 in which

may operate a dovetailed projection 20 on a large slide 21. This slide 21 preferably, rests upon the major portion of the base of the machine and provides the support for all of the wheel mounting means. The upper surface of slide 21 is provided with a suitable guideway in the form of a projection 22 extending at right angles to the dovetailed projection 20 on its lower surface. Supported on guideway 22 is a horizontally disposed slide 23 extending completely across the machine. Slide 23 as well as slide 21 are provided with central openings through which the spindle supporting member 11 and the spindle 12 extend so that these slides may move about through limited distances.

On this upper slide 23 are mounted suitable individual wheel supporting slides 25 which may be adjusted longitudinally on slide 23 by suitable screws 26 as shown in Figs. 1 and 2 to position them for operating on gears of different diameters. On slides 25 are mounted swivelling wheel heads 27 which may be clamped in any adjusted angular position upon the wheel slides 25 by the clamping bolts 28 as shown. The swivelling heads 27 are, in turn, provided with motors 30 which may be placed in driving connection with the wheel spindles 31 by means of suitable belts 32. On the lower surfaces of the swivelling heads are small ways 34 adapted to permit limited axial adjustment of the wheel heads 27. The swivelling heads 27 together with the wheels 35 may be moved axially of the spindles 31 by screws 34^a which may be rotated by hand wheels 34^b. On the spindles 31 are the abrasive wheels 35 each adapted to contact with the work upon one of their plane radial surfaces.

Fastened to opposite sides of the base 10 upon suitable supports 36 provided therefor is an arch 37 extending completely across the machine. This, in its mid position, is provided with an adjustable plunger 38 which is directly in alignment with the vertical rotating spindle 12 previously referred to. This plunger 38 and the spindle 12 are provided respectively with centers 39 and 40 which provide means for suitably mounting the work arbor 41 and the work blank A between them so that the blank may be rotated in a fixed axis. In this way, rotation of the spindle provides means to rotate the blank A in accordance with the rotation of the work spindle 12 and about a fixed axis.

Detachably fastened to the upper end of the vertical spindle 12 is a master gear 45, this being of exactly the same diameter, pitch and number of teeth as the gear blanks A which are to be ground. As this matter gear 45 must be chosen with particular reference to the gears being ground, it is made readily removable so that other master gears may be substituted therefor when gears of different types and sizes are to be ground. This master gear 45 is adapted to contact with gear teeth 46 formed on the periphery of an elongated elliptical opening provided in the plate 47 mounted on the upper slide 23. The form of this tooth periphery is generally elliptical but is such that opposite portions have short sections having teeth of rack form. These are indicated at 48 and extend between the points marked "a" on the periphery of the opening. The ends of the toothed periphery, including all of the toothed periphery except that of rack form, comprise segments of internal gears. It will be seen from this construction that rotation of the vertical spindle 12 and the master gear 45 thereon will first force the slides 21 and 23 in one direction and then in directions at right angles thereto, and in all other directions so that the master gear 45 will always remain in contact with some portion of the periphery of its toothed elliptical opening formed in the plate 47. Also, as the wheels 35 are mounted on the upper slide 23 they will partake of the combined movements of this as well as of the lower slide. Due to the wheels being mounted on the lower slide 21, they will be alternately moved into and out of engagement with teeth on the blank A and, while they are retained in contact with the blank, the blank will be in effect rolling past them as if it were being rolled upon or along a rack. In this way, involute toothed curves will be formed upon the gear blank.

During operation the work engaging surfaces of the wheels 35 are adjusted by means of the screws 26 and 34^a so that they are disposed in alignment with the flank surfaces of the rack teeth 48 on the plate 47. One of the abrasive surfaces is in alignment with one side of one of these teeth and the other abrasive surface with the opposite side of another rack tooth. In this way, one rotative movement of the master gear 45 sufficient for it to be engaged by all of the teeth in the toothed path in plate 47 will cause the abrasive wheels 35 to contact with opposite sides of different teeth. Each of the wheels 35 will be advanced into and withdrawn out of contact with opposite sides of teeth on the gear blank A. This action will take place during a relative rolling movement of the master gear 45 and the elongated internal gear formed by the teeth on plate 47. The result of this action therefore will be the formation of involute curves on the teeth of the blank contacted with by the wheels.

It will be seen also that if the toothed periphery of the plate 47 has a number of teeth incommensurate with the number of teeth in the master gear 45, and of the blank being ground, then each successive revolu-

tion of the blank A will vary the relative positions of the slides 21 and 23 carrying the wheels 35 with each complete revolution of the blank. In other words, one complete cycle of movements of the slides 21 and 23 due to the engagement of the master gear 45 with the entire periphery of the toothed opening in the plate 47 takes place while the master gear and blank rotate through more than a complete revolution. The rotative position of the blank A therefore, with each successive cycle of operations, will effect indexing of the blank A relative to the wheels 35. In this way no special indexing mechanism is required and continuous rotation of the spindle 12 and parts connected thereto will completely grind involute tooth curves upon each of the teeth in the blank A.

In operation, after the blank A has been mounted in position on the spindle 12 and the wheel heads 25 adjusted, the rotation of this blank will cause each of the wheels to contact therewith. Also, during operation to effect feeding movements of the blank relative to the wheels, the wheel heads 25 may be advanced slightly by means of the screws 34ª.

To retain the slide 23 toward either extreme of its movement to resiliently hold the wheels 35 alternately in contact with the work, a detent 50 is provided. This is pointed as shown and resiliently forced forwardly by means of a spring 51. Preferably the detent 50 may be slidably mounted in a projection 52 formed integrally on the slide 21. By these means lateral movement of the slide 23 causes the detent 50 to bear against opposite sides of a hardened pin 53 thus causing the slide 23 to be held in a position to cause engagement of the wheels 35 with the gear being ground.

What I claim is:

1. A gear grinding machine comprising in combination, a base, a work supporting and rotating spindle mounted thereon, a master gear on said spindle, two superposed slides on said base movable respectively at right angles to each other, a member on the upper slide having an internal toothed periphery, an abrasive wheel adjustably mounted on said upper slide, and means to rotate the spindle while said gear is retained in engagement with the teeth on said member and said slides are actuated to alternately engage and disengage the wheel with a blank on said spindle.

2. A gear grinding machine comprising in combination, a base, a work supporting and rotating spindle mounted thereon, a master gear on said spindle, two superposed slides on said base movable respectively at right angles to each other, a member on the upper slide having an internal toothed periphery, a portion of which has teeth of rack form, an abrasive wheel adjustably mounted on said upper slide, and means to rotate the spindle while said gear is retained in engagement with the teeth on said member and said slides are actuated to alternately engage and disengage the wheel with a blank on said spindle while the master gear engages the rack formed teeth on said member.

3. A gear grinding machine comprising in combination, a base, a work supporting and rotating spindle thereon, a master gear on said spindle, two superposed slides on said base movable respectively at right angles to each other, a member fixed to said upper slide having an internal toothed periphery, the number of teeth in said periphery being incommensurate with the number of teeth in the master gear and the gear blank being operated on, an abrasive wheel adjustably mounted on said upper slide, and means to rotate the spindle whereby said master gear engages the teeth on said member having the toothed periphery and said slides are actuated to alternately engage and disengage the wheel with successive teeth on said gear blank.

4. A gear grinding machine comprising in combination, a base, a work supporting and rotating spindle mounted in fixed position thereon, a master gear on said spindle, two superposed slides on said base movable respectively at right angles to each other, a member fixed to said upper slide having an internal toothed periphery, a portion of which has teeth of rack form, the number of teeth in said periphery being incommensurate with the number of teeth in the gear blank being operated on, an abrasive wheel adjustably mounted on said upper slide, and means to rotate the spindle whereby said master gear is retained in engagement with the teeth on said member having the toothed periphery and said slides are actuated to alternately engage and disengage the wheel with successive teeth on said gear blank while said master gear engages said teeth of rack form.

5. A gear grinding machine comprising in combination, a base, a work supporting and rotating spindle mounted in fixed position thereon, a master gear on said spindle, two superposed slides on said base movable respectively at right angles to each other, a member fixed to said upper slide having an internal toothed periphery, a portion of which has teeth of rack form, the number of teeth in said periphery being incommensurate with the number of teeth in the gear blank being operated on, an abrasive wheel adjustably mounted on said upper slide and adapted to engage a work blank upon one of its plane radial surfaces, and means to rotate the spindle whereby said master gear is retained in engagement with the teeth on said member having the toothed periphery and said slides are actuated to alternately

engage and disengage the wheel with successive teeth on said gear blank while said master gear engages the teeth of rack form.

6. A gear grinding machine comprising in combination, a base, a vertically disposed work supporting and rotating spindle thereon, a master gear on said spindle, two superposed horizontally movable slides on said base movable respectively at right angles to each other, a member on said upper slide having an internal toothed periphery of elongated form adapted to engage the teeth of said master gear, oppositely disposed abrasive wheels on the upper slide, and means to rotate the spindle whereby a gear blank on said spindle will be alternately engaged and disengaged by said wheels and the engagement of the master gear with the toothed periphery of the member on the upper slide will actuate said slides to cause the engagement and disengagement of said wheels with the gear blank.

7. A gear grinding machine comprising in combination, a base, a work supporting and rotating spindle thereon, a master gear on said spindle, two superposed slides on said base movable respectively at right angles to each other, a member on said upper slide having a toothed periphery adapted to engage the teeth of said master gear, oppositely disposed abrasive wheels on the upper slide, means to rotate the spindle whereby a gear blank on said spindle is alternately engaged and disengaged by the wheels on said upper slide and the engagement of the master gear with the toothed periphery of the member on the upper slide actuates said slides to cause said engagement and disengagement, and resilient means acting upon one of the slides to hold said wheels alternately in contact with the blank.

In testimony whereof, I hereto affix my signature.

ARTHUR L. WILDER.