A. L. STEWART.

MACHINE FOR FINISHING OR GRINDING WORM GEARS.

APPLICATION FILED MAY 8, 1915.

1,194,566.

Patented Aug. 15, 1916.

3 SHEETS—SHEET 1.

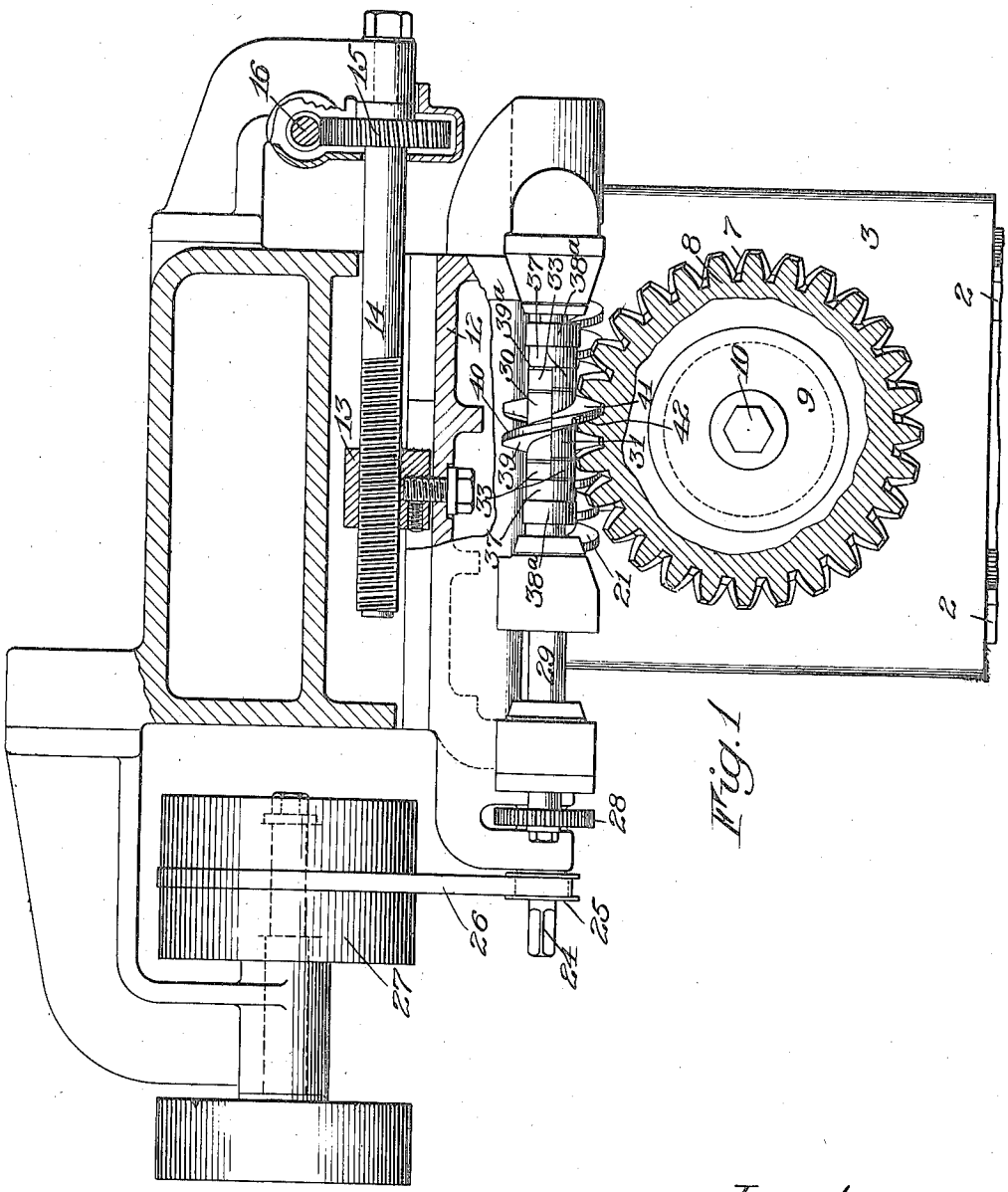


Fig. 1

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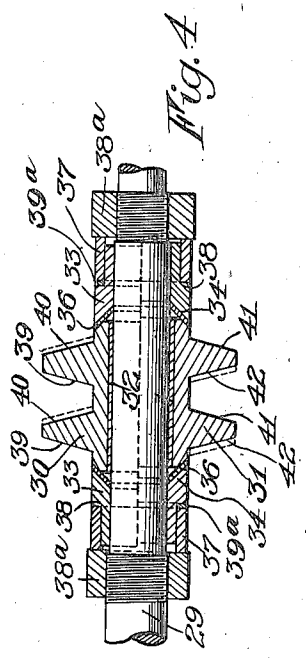


Fig. 4

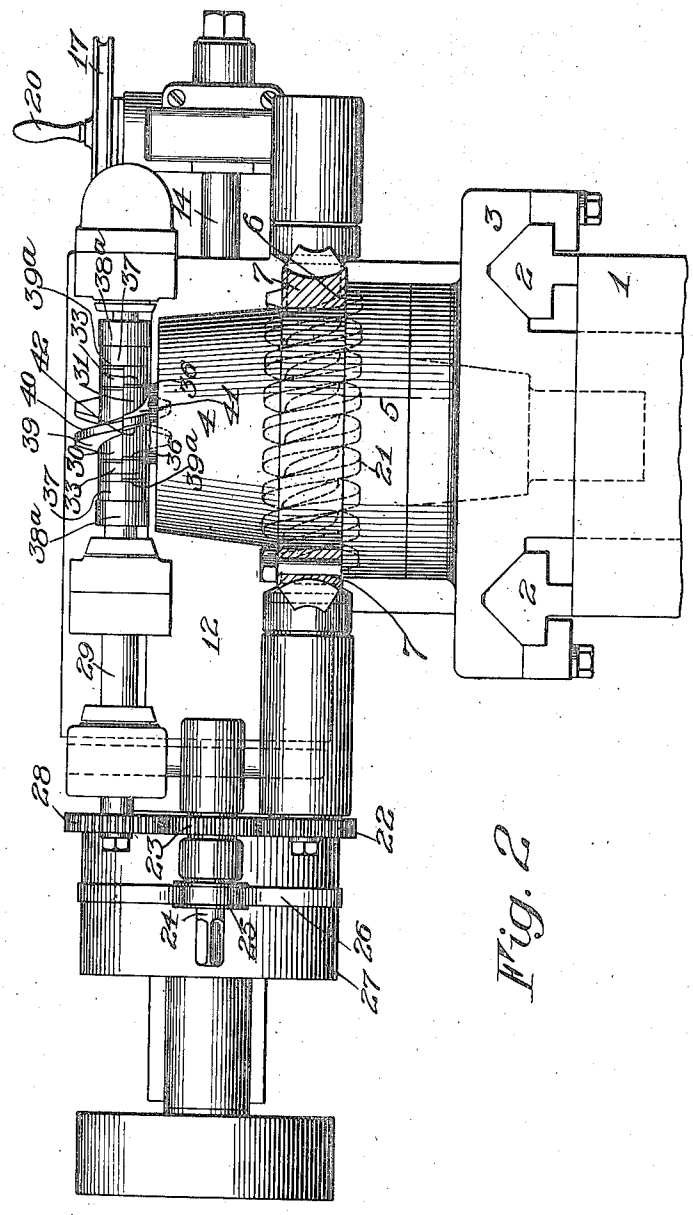


Fig. 2

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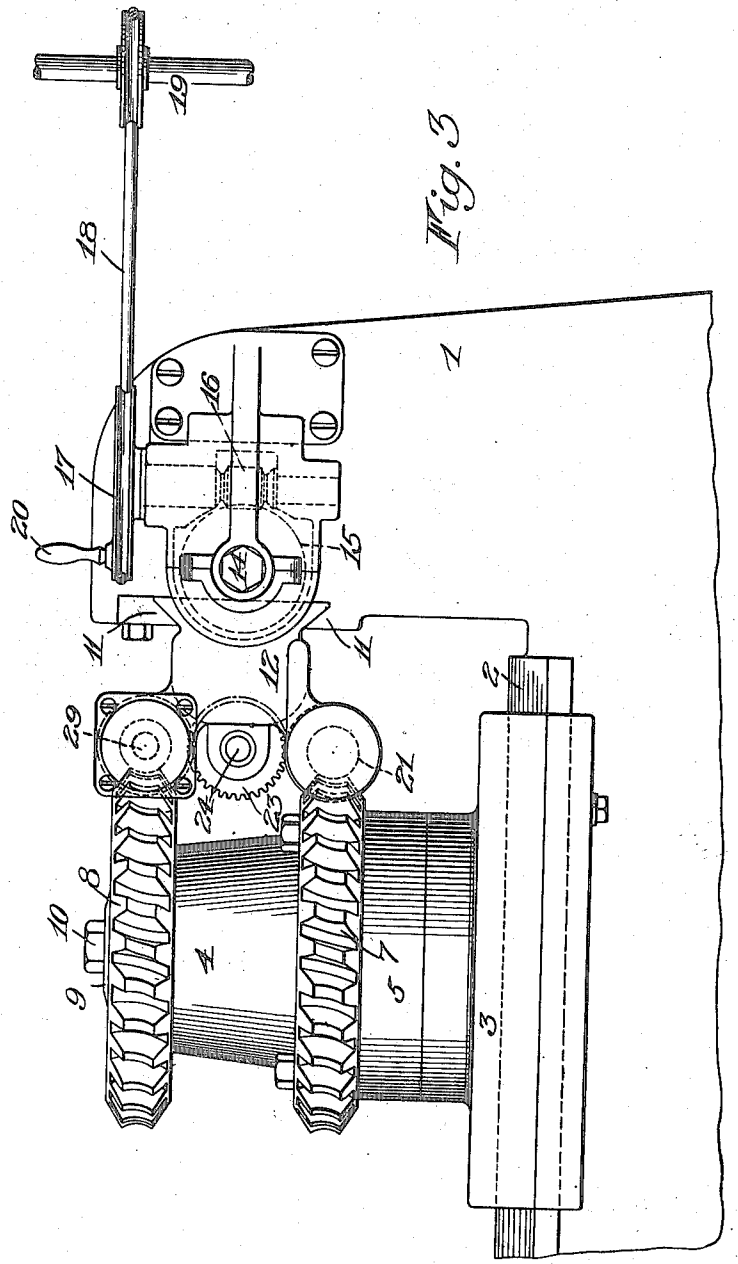
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3 SHEETS—SHEET 3.

Fig. 3



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UNITED STATES PATENT OFFICE.

ARTHUR L. STEWART, OF ROCHESTER, NEW YORK, ASSIGNOR TO GLEASON WORKS, OF ROCHESTER, NEW YORK, A CORPORATION OF NEW YORK.

MACHINE FOR FINISHING OR GRINDING WORM-GEARS.

1,194,566. Specification of Letters Patent. Patented Aug. 15, 1916.

Application filed May 8, 1915. Serial No. 26,881.

To all whom it may concern:

Be it known that I, ARTHUR L. STEWART, of Rochester, in the county of Monroe and State of New York, have invented certain new and useful Improvements in Machines for Finishing or Grinding Worm-Gears; and I do hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming a part of this specification, and to the reference-numerals marked thereon.

The invention relates to gear grinding and pertains more particularly to the grinding of worm gears for the purpose of finishing them after having been previously cut and hardened, or for otherwise truing the surfaces of worm gears.

The particular object of the present machine is to afford a mechanism by which the teeth can be accurately formed, in such a manner as to obtain theoretically correct profiles through the instrumentality of a relative generating movement that is produced beween the work support and the grinding tool.

A further feature of the invention resides in a novel form of adjusting means which makes it possible to change the relation of the blank and tool so as to insure proper engagement between opposite grinding surfaces of the tool and opposite sides of the tooth.

To these and other ends the invention consists in certain improvements and combinations of parts, all as will be hereinafter more fully described, the novel features being pointed out in the claims at the end of the specification.

In the drawings: Figure 1 is a plan view partially in section illustrating a possible application of the invention; Fig. 2 is a view in side elevation; Fig. 3 is an end elevation, and Fig. 4 is a longitudinal sectional view of the cutting or grinding tool.

Similar reference numerals throughout the several views indicate the same parts.

The invention may be carried out in quite a number of different ways and consists essentially in employing a grinding member in the form of a worm or section thereof arranged for engagement with a blank, the movements of the tool and blank being positively determined by a master worm and worm gear which are operatively connected to the tool and blank. During the grinding operation, a relative generating movement is imparted to the tool and blank which compensates for the periods when portions of the tool are out of grinding relation with the work as will be more fully described presently.

The invention also contemplates operating on both sides of the teeth of the gear during each rotation of the latter which result is accomplished by constructing the grinding tool with a plurality of offset cutting portions preferably formed in separable sections, the arrangement being such as to permit successive sections of the grinding thread to coöperate with opposite sides of a tooth, by which means it is possible to obtain a much faster and generally more efficient operation that insures properly shaping the teeth.

The chief difficulty that heretofore has been experienced in connection with worm gearing has been due to the fact that the teeth of a worm gear wear away quite rapidly unless they are hardened after completing the cutting operation. It has not been practicable to thus harden gears because of the change in the metal which such a hardening operation produces, resulting in possible shrinking or expansion of different parts of the surface of the gear which throws the entire relation of the worm and gear out of true coöperation.

The mechanism herein shown and described is intended as more or less schematic and indicates a possible adaptation of the improvement in operative form, although other structures can be devised that will successfully accomplish the desired result within the contemplation of my invention.

In the arrangement shown 1 designates a bed or main frame of the machine provided with ways or tracks 2 for supporting the carriage 3 which is adjustable on the tracks 2 and can be secured in adjusted position. Arranged on the carriage 3 is the work support designated generally at 4 and rotatably arranged on the carriage. The work support 4 includes a base 5 surmounted by a ledge or shoulder 6 upon which rests a master or pattern worm gear 7 which may be fixedly arranged in any convenient manner. 8 designates the blank or work mounted on the top of the work support as shown in Fig. 3 and held in stationary relation

with the work support by any desirable means as for instance, by the head plate 9 and bolt 10. The bed 1 also includes an upstanding portion or standard that is provided with tracks 11 forming guideways within which is movably arranged a tool carriage 12. Connected to the carriage 12 is a block 13 which is interiorly threaded and engaged by the threaded stem 14. The latter is provided with a worm gear 15 driven by the worm 16 which is secured on a spindle carrying a pulley 17. The latter can be driven by a belt 18 connecting with a power pulley 19, while 20 is a handle attached to the pulley 17 and by which it may be manually operated if desirable.

The tool carriage 12 is provided with a master or pattern worm 21 arranged to engage the aforementioned pattern worm gear 7. The worm 21 is secured on a shaft which carries a gear 22 driven by the gear 23 which in turn is fixed on the shaft 24. The latter carries the pulley 25 arranged for engagement with belt 26 which is operated from the driving pulley 27. The gear 23 also drives gear 28 fixed on the shaft 29 upon which the grinding tool is mounted as will now be described.

The tool of the present embodiment comprises a pair of sections 30 and 31 formed of suitable material such as carborundum, each consisting of a semi-cylindrical portion that fits the shaft on which it is mounted and a thread portion constituting a section of a worm corresponding to the master worm 21. The sections 30 and 31 are provided with linings 32 of lead or similar soft metal which serve to prevent excessive wear on the shaft and also enable the tool sections to be engaged with the shaft more firmly by reason of the fact that the lining portions 32 compensate for any unevenness of contact between the shaft and the tool. The sections of the tool are held in place by means of semi-cylindrical followers 33 which have inclined inner faces 34 for engagement with correspondingly inclined or beveled faces on the tool sections and arranged between the followers and the tool sections are wear plates 36 formed of lead or other soft metal and having the same action as the lining plates 32.

37 are annular sleeves, one surrounding each pair of followers 33 and coöperating with shoulders 38 on the followers, the sleeves 37 being held in place by nuts 38 threaded on the spindle.

39 designates spacing plates which are semi-annular, corresponding to the sections 30 and 31 and adapted to be arranged between the sleeves 37 and the followers 33. By this means the sections of the tool may be adjusted relatively to each other to any desired degree as shown in Fig. 2. From Figs. 1 and 4 it will be seen that the surface 39 of the tool grinds upon the right hand face of the tooth of Fig. 1 and during such operation the surface 40 of the tool is out of grinding relation with the blank in the same way, surface 41 of the tool engages the left hand face of the tooth, while surface 42 is disengaged from the blank.

In the operation of the machine, the blank is secured in place and the grinding sections adjusted to the desired depth, and upon starting the parts, the grinding member travels through the blank in the same manner as the master worm travels through the master gear, the sections of the grinding tool operating first on one side and then on the opposite side of a tooth. When the abrasive material becomes worn, or it is desired to vary the depth of grinding, the guiding sections are relatively operated by inserting or removing some of the spacing plates 39.

I claim as my invention:

1. In a machine for grinding worm gears, the combination with a rotary work support and means for driving it at uniform speed, of a guideway tool embodying a section of a worm formed of abrasive material and rotatable in engagement with a blank on the work support, the tool having movement longitudinally of its axis during the cutting operation.

2. In a machine for grinding worm gears, the combination with a rotary work support and means for driving it at uniform speed, of a grinding tool embodying a section of a worm formed of abrasive material and rotatable in engagement with a blank on the work support, and means for effecting a relative generating movement between the tool and blank during the cutting operation in addition to that due to their normal engaging relation.

3. A grinding tool embodying a plurality of worm sections formed of abrasive material and adjustable with relation to each other, the alternate worm sections being adapted for engagement with opposite sides of a tooth on a gear blank.

4. In a machine for grinding worm gears, the combination with a rotary work support, of a master worm gear fixed on the support, a driving worm engaging said worm gear, a grinding tool embodying a section of a worm formed of abrasive material rotatable in engagement with a blank on the work support and means for operating the driving worm and grinding tool.

5. In a machine for grinding worm gears, the combination with a rotary work support, of a master worm gear fixed on the support, a driving worm engaging said worm gear, a grinding tool embodying a section of a worm formed of abrasive material rotatable in engagement with a blank on the work support, means for operating the driving

worm and grinding tool, and means for effecting a relative generating movement between the tool and blank during the cutting operation in addition to that due to their normal engaging relation.

6. In a machine for grinding worm gears, the combination with a rotary work support, of a master worm gear fixed on the support, a driving worm engaging said worm gear, a grinding tool embodying a section of a worm formed of abrasive material rotatable in engagement with a blank on the work support, and the tool having movement longitudinally of its axis during the cutting operation.

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