

No. 874,448.

PATENTED DEC. 24, 1907.

W. H. SMITH.
METHOD OF MAKING GEAR WHEELS.

APPLICATION FILED AUG. 8, 1906.

2 SHEETS—SHEET 2.

Fig. 2.

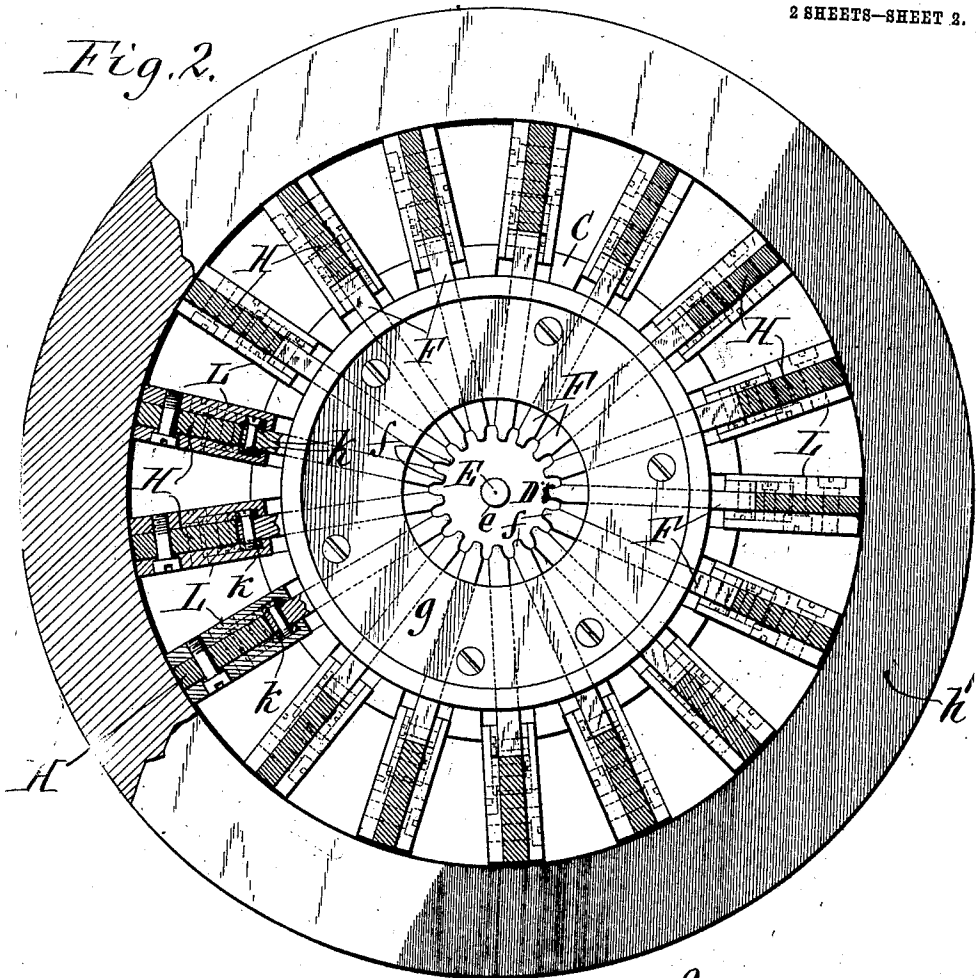
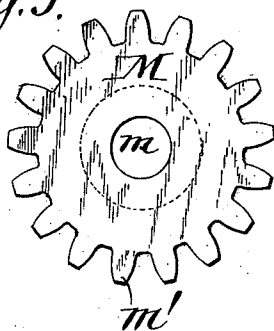
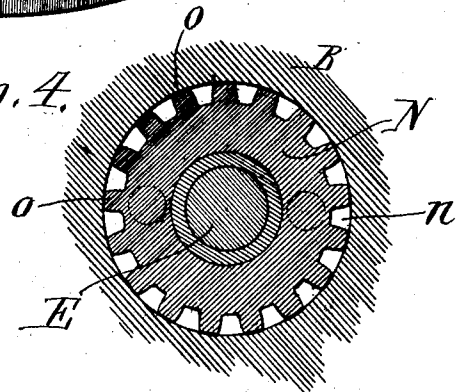


Fig. 5.



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Fig. 4.



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UNITED STATES PATENT OFFICE.

WILLIAM H. SMITH, OF BUFFALO, NEW YORK, ASSIGNOR OF ONE-HALF TO JOHN R. KEIM MILLS, INC., OF BUFFALO, NEW YORK, A CORPORATION OF NEW YORK.

METHOD OF MAKING GEAR-WHEELS.

No. 874,448.

Specification of Letters Patent.

24, 1907.

Application filed August 8, 1906. Serial No. 329,666.

To all whom it may concern:

Be it known that I, WILLIAM H. SMITH, a citizen of the United States, residing at Buffalo, in the county of Erie and State of New York, have invented a new and useful Improvement in Methods of Making Gear-Wheels, of which the following is a specification.

This invention relates more particularly to a method of making gear wheels which may be run at high speed and subjected to hard usage without producing noise or wearing unduly. One of the methods heretofore employed for making gear wheels consisted in cutting the teeth thereof by means of a milling tool. This necessitated using comparatively soft metal in order to permit of cutting the same which necessarily caused the gear wheel when in use to wear rapidly. Hardening of the gear wheel after being cut is not permissible inasmuch as this has a tendency to distort the teeth and render the same inaccurate.

In order to increase the wearing capacity of gear wheels it has been proposed to forge them of very hard metal which method however is impracticable for producing perfect gear wheels because of the imperfections in the forging and the difficulty of grinding or cutting the teeth so that they will run smoothly and noiselessly.

The object of this invention is to produce perfect running and durable gear wheels expeditiously and at comparatively low cost.

In the accompanying drawings consisting of two sheets: Figure 1 is a sectional elevation of one form of a press which is suitably constructed for practicing my invention and showing the teeth swaging dies in their projected or operative position. Fig. 2 is a horizontal section of the same in line 2-2 Fig. 1. Fig. 3 is a fragmentary horizontal section, on an enlarged scale, in line 3-3 Fig. 1 but showing the teeth swaging dies retracted into their inoperative position. Fig. 4 is a fragmentary horizontal section, on an enlarged scale, in line 4-4 Fig. 1 showing part of the means for ejecting the finished gear wheel from the press. Fig. 5 is a detached bottom plan view of the endwise swaging punch.

Similar letters of reference refer to like parts in the several figures.

In practicing my invention, a circular or cylindrical blank of approximately the size

of the gear wheel desired is first cast forged or otherwise formed of metal which when cool is very hard and has the capacity of resisting wear to a great extent. This blank is then heated sufficiently to render the same more pliable and capable of being swaged into desired shape under pressure. While thus heated the blank is subjected to the pressure of an annular row of radially movable dies which are operated to simultaneously press against the entire periphery of the blank and swage or displace the metal of the same so as to produce an annular row of gear teeth thereon the working faces of which are finished and run smoothly and noiselessly in mesh with the teeth of other gear wheels which have teeth of equally perfect construction. After the teeth have been thus formed and finished on the blank the same is subjected to pressure in a direction lengthwise of its axis so as to condense the metal and swage the same outwardly sufficiently to fully engage the teeth forming dies and produce teeth having full and uniform bearing surfaces.

The apparatus for practicing my improved method of making gear wheels may be variously constructed, that shown in drawings, for example, being suitable for the purpose and constructed as follows:

A represents the base or bed of a stamping or swaging press or machine which is provided centrally on its upper side with a pocket which has a flat bottom B and a cylindrical side wall C, and is normally open at the top to permit of inserting the gear blank D axially into the pocket or removing the same therefrom. This blank may be either a solid cylinder or the same may be rough-cast of partly formed or unfinished gear teeth on its periphery, as shown in Fig. 2, so as to approximate its finished form and reduce the work of the machine in putting it into finished condition. The gear blank is preferably centered in the pocket by means of an upwardly projecting stud E arranged centrally from the bottom of the pocket and entering the bore *e* of the gear blank.

F represents a plurality of radially movable slides provided at their inner ends with dies *f* which are constructed to form finished gear teeth on the periphery of the blank. These slides are guided in equidistant radial

ways G formed partly by grooving the side wall of the pocket from the top and partly by an annular retaining ring *g* secured to the top of said wall and closing the upper ends of the grooves in the same.

The means shown in the drawings for moving the slides radially inward comprises a plurality of vertically movable wedges H each of which has a straight back *h* engaging with the straight face of a thrust wall or flange *h'* on the base and an inclined front face *i* which engages with the inclined face *i'* at the outer or rear end of one of the slides K. The several wedges are secured at their upper ends to a vertically reciprocating head J which may be operated by any suitable means. The outward or backward movement of the slides is effected by means of inclined cleats or ribs *k* arranged on opposite sides of the outer ends of the slides and plates L secured to the lower ends of the wedges and having inclined ribs engaging with the inner side of the ribs on the slides, as shown in Figs. 1 and 2.

Preparatory to placing the blank in the pocket the head J is raised so as to retract the dies of the slides outside of the bore of the pocket. After heating the blank to the required degree the same is placed in the pocket as shown in Fig. 3, and then the head J is lowered causing the several dies of the slides to simultaneously engage the periphery of the gear blank and swage or press the metal of the blank so as to form the pitch surfaces of an annular row of gear teeth on the same, as shown by full lines in Fig. 2 and by dotted lines in Fig. 3. After the teeth forming dies have thus formed the teeth on the periphery of the blank and are still in engagement therewith the blank is subjected to pressure in the direction of its axis for condensing the metal and causing the metal to fully engage the teeth forming dies for producing full and uniform teeth. The means for thus condensing the blank endwise consists preferably of a vertically movable punch M arranged to engage the upperside of the blank and having a central recess *m* on its underside for the reception of the centering stud and longitudinal corrugations *m'* on its periphery which fit between the teeth forming dies.

The movement of the metal to conform to the shape of the tooth forming dies is made possible by the preliminary heating of the same. The teeth when thus formed have true working faces or pitch surfaces on their sides and do not require further dressing for this purpose. The bore of the pocket which receives the gear blank is preferably of such diameter that the same is engaged by the outer end of the gear teeth the same are finished on the blank. This however is not necessary inasmuch as the bore of the tooth is made sufficiently deep to allow for any

slight variation in the length of the teeth of the cooperating gear wheel.

If desired the outer ends of the gear teeth may be dressed off which can be done without disturbing the contact faces thereof.

After the gear wheel has been finished the endwise condensing punch and the tooth forming dies are withdrawn from the same and the gear wheel is removed by means of an ejector N. The latter is preferably constructed in the form of a ring normally seated in a correspondingly shaped recess *n* in the bottom of the pocket so as to be flush with the top thereof. At its periphery the ejector has an annular row of teeth *o* which are opposite the spaces between the teeth forming dies. Upon raising the ejector after the gear wheel has its teeth formed the latter is lifted out of the pocket and from the centering stud. The lifting of the ejector may be effected by means of vertical rods *p* guided in vertical openings in the base and connected at their upper ends with the ejector while their lower ends are connected with a suitable operating device.

By the use of my improved method gear wheels having perfectly finished and noiselessly running teeth may be produced expeditiously of metal having a degree of hardness which cannot be worked economically by cutting tools and having the capacity of resisting wear to a high degree. This method therefore effects a considerable saving in cost of manufacturing and maintaining gear wheels which are run at a high speed as for instance, the gear wheels of automobiles or railway motors.

This method is not restricted to making gear wheels from very hard metals which cannot be economically cut by forming or milling tools but may also be used for making gear wheels of softer or milder metals at less cost in as much as the pitch surfaces of the teeth may be produced without requiring further milling or forming of the teeth.

I claim as my invention:

The herein-described method of making gear wheels consisting in first rough forming a circular metal blank with an annular row of gear teeth, then heating the blank sufficiently to permit swaging of the same, then subjecting the blank to radial forging pressure simultaneously between all of its teeth for truing the bottom and sides of the teeth, and at the same time limiting the outward movement of the metal at the heads of the teeth so as to true these parts of the teeth, substantially as set forth.

Witness my hand this 31st day of July, 1906.

WILLIAM H. SMITH.

Witnesses:

THEO. L. POPE,
E. M. GRAHAM.