UNITED STATES PATENT OFFICE.

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METHOD OF PRODUCING FINISHED TEMPERED GEAR.

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To all whom it may concern:

Be it known that I, CLARK W. PARKER, a citizen of the United States, residing at Springfield, in the county of Hampden and State of Massachusetts, have invented certain new and useful Improvements in Methods of Producing Finished Tempered Gear, of which the following is a specification.

My invention pertains to the manufacture of tempered gear wheels, and consists in certain steps performed in a definite order as hereinafter set forth, the salient feature of the method or process being the final machine cutting or finishing of the gear teeth after the oil tempering is done.

The preliminary steps of the process may be more or less varied in detail, and in order or sequence, provided the finishing machine cut be made after the oil tempering is completed. It is particularly to be observed that I employ a cutting as contradistinguished from a grinding or abrading tool, for the finishing operation, it being impracticable to attain the ends in view through the use of a grinding wheel or implement in place of the cutting tool.

Under present methods of manufacture, gear wheels of steel usually receive their finishing cuts prior to tempering. Such tempering involves heating to a relatively high temperature, sudden cooling or chilling at a relatively low temperature, and final subjection or raising to an intermediate temperature, usually in a bath of oil, tallow, or the like. The tempering process almost invariably begets greater or less distortion of the gear wheel, causing it to bind at some points and run unduly free at others, entailing waste of power, generation of noise, vibration of the machinery, and other seriously objectionable effects. It is hence desirable that the wheels after receiving the final dressing cut by which they are brought to the precise form and dimensions intended, shall not be subjected to any temperature effects liable to distort the wheel or any portion of it, and the present invention hence is directed to making such finishing cut after the tempering is completed.

Before entering upon a detailed statement of the process, or reciting the steps and the sequence of steps performed in carrying out my improved method of producing gears, it may be noted that objects cast in chill molds, such, for instance, as grinding or crushing rolls for grain, and still other objects, including gear wheels, formed of very hard material such as manganese steel, have received a final finishing by means of grinding wheels. This I do not intend to claim, first, because it is not of my invention, and secondly, for the reason that it is incapable of producing the results sought and attained by me. The impossibility of maintaining any grinding wheel or body in such perfect form as to insure absolute precision in the size and form of the teeth of gear wheels ground thereby, and the impracticability of introducing any efficient grinding device into the spaces between the small teeth of fine toothed gear wheels, preclude the use of such grinding process for the purposes of my invention. This will be realized when it is stated that by my process I am enabled practically and uniformly to produce, and operatively mesh and drive, tempered gear wheels having but about two one-thousandths (0.002) of an inch clearance or backlash, with a resultant absence of noise even when several gears are in mesh, as, for instance, in the case of second or reverse gears used in automobile transmissions and the like. In other words, the clearance is so slight as to admit only a thin film of oil between the teeth, sufficient for proper lubrication.

Having thus set forth in outline the nature of my invention, and the features wherein it is differentiated from prior methods or processes, I will proceed to give in detail a typical or illustrative statement of the operations performed in producing a gear by my method.

Any oil tempering steel may be used. In practical use of the invention for purposes of test and demonstration, I have used with very satisfactory results what is known to the trade as "Carpenter's #5-317 chrome nickel gear steel." This, however, is mentioned merely as one of various commercial steels suitable to the carrying out of my invention.

Having selected a suitable steel, gear blanks are produced in the usual way and of proper dimensions, and are bored to within ten one-thousandths (0.010) of an inch of the finish size, or ultimate bore. A rough cut is then given to the teeth or teeth-forming portion of the blank in the usual way, except that the cutters are ground of such form and dimensions that the rough-cut

tooth shall have the depth of the finished tooth, and shall have a total of about twenty one-thousandths (0.020) of an inch additional thickness on the working face, or at the pitch line. The gear or blank is next placed in a furnace, and subjected to an even heat of approximately 1500° F., after which it is removed from the furnace, and promptly quenched in oil at approximately 200° F. When its temperature is brought to that of the oil bath, that is, to 200° F. or thereabout, it is placed in a bath of suitable fluid, preferably horse tallow, heated to about 400° F. The tallow bath is thereafter brought up to a temperature of approximately 500° F., or until on a Shore scleroscope it will register say from 70 to 80 hard, according to the particular work the gears are designed to perform.

The next operation is that of grinding the hole in the blank to the finish size.

The final operation is performed with a special carbon steel cutter, so ground on its periphery that in making the finishing cut it will not bottom. A stream of proper cutting lubricant, preferably turpentine, is used instead of the usual cutting compound or oil commonly employed, and is kept constantly flowing upon the cutter at the working point while the work is being done. A speed of about seventy-five strokes per minute on a Fellows gear shaper is about the limit of cutting speed for a gear of one inch face, where the particular steel above mentioned is used.

The finishing cut is preferably such as will permit an ordinary sheet of tissue paper one one-thousandth (0.001) of an inch in thickness to run readily between the meshing teeth of two gears, so that they will run without back-lash, or just as close as said gears can run with a film of oil between coacting teeth.

The foregoing states a typical case. It will, of course, be understood that any suitable steel may be employed, and that the preliminary operations of producing and shaping the blank, the selection of hardening and tempering baths, temperatures, etc., may vary within customary limits, and according to the intended use of the gears produced, the essential point being the making of the finishing cut after completion of the oil tempering operation. An important point is the leaving of the extra thickness prior to tempering, whereby there is afforded sufficient material to permit the finishing cut to be made and enable the gear wheel to be brought to the precise form and dimensions intended after the tempering has been completed.

My invention may, of course, be made use of in the production of toothed gearing of any form, whether wheels and pinions, racks, elliptic gear, mutilated gear, or others.

Having thus described my invention, what I claim is:—

1. The herein described method of producing gear wheels, which consists in first forming a blank; second, cutting the teeth thereon to finish depth, but of dimensions in excess of finish dimensions; third, tempering the gear while in this condition; and lastly, reducing the teeth to final form and dimensions by a cutting as distinguished from a grinding operation.

2. The method of producing finished gears which consists in the following steps; first, producing a gear blank in any usual way; second, boring the same to within a few thousandths of an inch of finish size; third, cutting the teeth to full depth but of a thickness approximately twenty one-thousandths (0.020) of an inch greater than finish thickness on the working face or at the pitch line; fourth, tempering the blank; fifth, grinding the hole to finish diameter; sixth, cutting the gear teeth to finish dimensions.

3. The method of producing true and accurate toothed gearing, which consists in tempering the gear blank prior to reducing the same to finish dimensions; and bringing said gear to finish dimensions by a finishing cut performed after such tempering.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

CLARK W. PARKER.

Witnesses:
F. E. LADD,
ROBERT ROSSING.