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A. W. COPLAND ET AL

METHOD FOR TRUING GEARS AND THE LIKE

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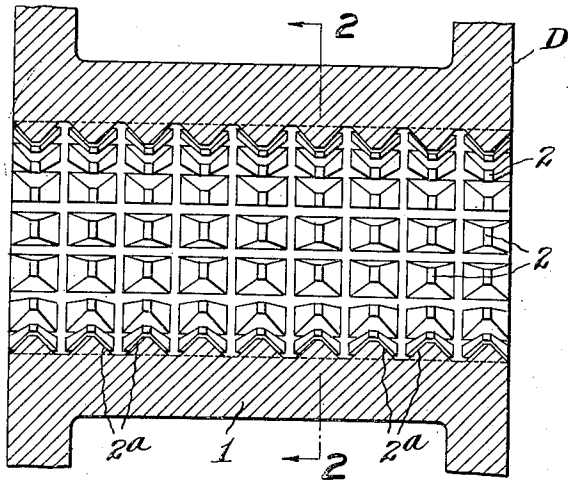


FIG. 1.

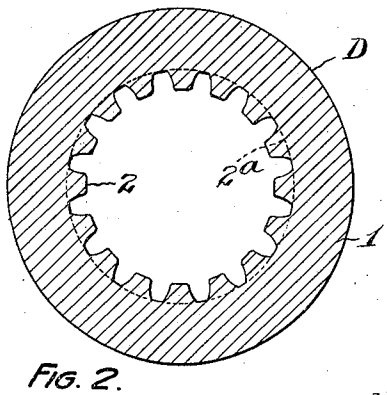


FIG. 2.

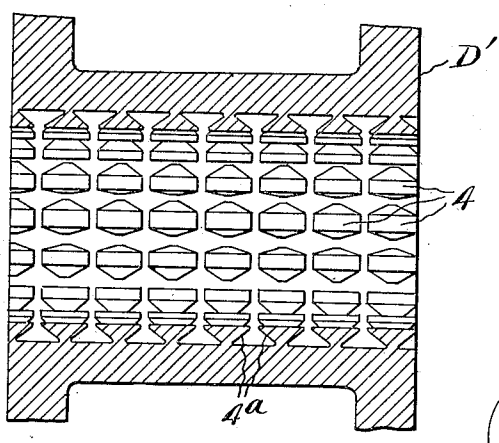


FIG. 3.

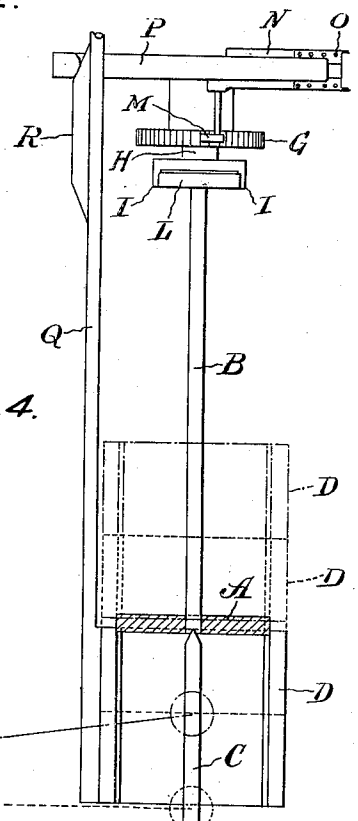
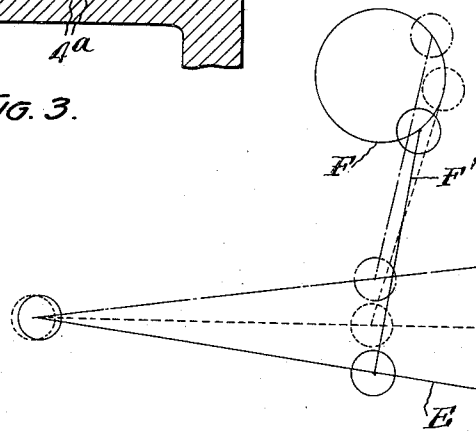


FIG. 4.



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UNITED STATES PATENT OFFICE.

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METHOD FOR TRUING GEARS AND THE LIKE.

Application filed March 23, 1927, Serial No. 177,743, and in Great Britain September 14, 1926.

The invention relates to the art of truing gears by grinding or lapping, and more particularly to an improved form of lap suitable for use in the lapping of gears by applicants' method as set forth in their copending application Serial No. 551,141, filed April 10, 1922. The present application is in part a continuation of a divisible part of our copending application Serial No. 551,140, filed April 10, 1922. It may also be considered a similar continuation in part of our application Serial No. 551,141 referred to above; its purpose being to show a relation between features of both, which, though obvious when both are considered together, was not as fully indicated in either as applicants desire.

The method of our application Serial No. 551,141 is applicable to the truing of various bodies which have radiating surfaces uniformly spaced in circular series, but the method is especially useful in the lapping of gears and for the sake of simplicity, we will refer to the object to be lapped as a gear. In the lapping of the gear by the method in question a lap is provided formed with teeth oppositely disposed and complementary to the teeth of the gear and having a pitch circle substantially equal to the pitch circle of the gear. This lap and the gear to be lapped are registered with each other in the relation of axially coincident internal and external inter-meshing gears, then one is reciprocated with respect to the other in mutual abrasive contact, and intermittently one is progressively rotatably advanced in relation to the other to change the registration of the teeth. If the gear is a spur gear, the lap of course takes the form of an internal gear and, vice versa, if the gear to be lapped is an internal gear, the lap takes the form of a spur gear. The lap is preferably elongated or widened axially in order to afford adequate abrasive area.

In such a lapping or grinding operation the amount of grinding or abrading of a surface sliding in contact with another surface is dependent first, on the character of the abrasive material used; second on the area of abrading surface that is moved over each unit area of the surface to be ground or trued; and third, the amount of pressure per unit area of contact.

The invention has for its chief object the provision of an improved method of the general character disclosed in our application Serial No. 551,141, by the use of which it is possible to vary the second of the three factors above noted and thereby control the amounts of material ground off from different portions of the teeth of the gear to be lapped.

In the accompanying drawing we show apparatus suitable for the carrying out of the invention. In the drawings,

Fig. 1 is a longitudinal section through an annular, internally toothed lap.

Fig. 2 is a cross section on the line 2—2 of Fig. 1.

Fig. 3 is a view corresponding to Fig. 1 showing a modified form of construction.

Fig. 4 is a diagrammatic view illustrating the operation of the apparatus disclosed in our said application Serial No. 551,141, in conjunction with which our present invention is adapted to be used.

Referring first to the diagram of Fig. 4, the gear wheel A, or other object to be ground, is fixed to the arbor B which is rotatably supported on the centering spindle C having a fixed connection with the frame of the machine. A lap D, having corresponding projections adapted to register with the gear teeth, is mounted to reciprocate vertically relative to the gear to be ground. This vertical reciprocation is effected by means of the arm E which is connected at one end to the lap and is operated as shown by means of a suitable crank F and link F'. We have shown by full, dotted, and dot and dash lines three positions of the lap D and its operating mechanism during their travel.

In order to insure a grinding contact between the mutually engaging surfaces a torsional force is applied to the gear wheel during its engagement with the lap. The ratchet wheel G is fixed to a rotatably mounted member H which carries projections I fitting in slots formed in the member L which in turn is fixed to the arbor B which carries the gear to be ground. The ratchet wheel G is engaged by a pawl M carried by a slide N which latter is actuated by a spring O, which in turn is actuated by a rod P. Q is a member fixed to the lap reciprocating mechanism, and is provided with a cam portion R for engaging the rod P to actuate the

same to place a tension on the spring O. The parts are so constructed and arranged that when the gear wheel is out of engagement with the lap (which occurs at each end of its stroke) no pressure will be exerted by the cam on the rod P, and consequently the spring O will be at zero tension. The arrangement of parts is such that as the teeth of the lap enter into, and leave, engagement with the teeth of the gear to be ground, the inclined surfaces of the cam portion will move into, and out of, engagement with the rod P, and as a result the torsional pressure between the contacting surfaces of the gear and lap teeth will be progressively increased and decreased as they are brought into and out of engagement, respectively. It will thus be seen that during the period that the cam portion R is in operative engagement with the rod P a torsional force is being applied to the gear wheel which will result in the setting up of a grinding contact between the mutually engaging surfaces.

As stated, in the operation of the apparatus as above indicated, the gear and lap move out of mutual engagement at the end of each stroke of the lap, and in carrying out the method of our application Serial No. 551,141, during such disengagement of the gear and lap we effect (by means not shown in the diagram) predetermined relative angular movement of the gear and lap, to intermittently change the registration of the gear and lap teeth.

The chief results attained by the method just described are the accurate equi-spacing of the teeth of the gear, and the averaging of the tooth contours of the gear. In case the tooth contours of the gear to be trued approximate the true involute or other form desired, the method which has been described will give satisfactory results. On the other hand, if the initial tooth contours vary substantially from the form desired, as by having too great fullness at the crown, or too great fullness near the root of the tooth, then the true predetermined contour desired cannot be attained by the said method. Again, in case it should be desired to effect a definite predetermined change in the tooth contour of a gear, as by removing more of the metal or less of the metal from the crown portion than from the root portion of the tooth, this cannot be accomplished by the above described method. In carrying out our present invention, however, we provide an improved form of lap which is applicable to the method above described and by use of which the ends last referred to above can be attained.

Referring first to the form of lap shown in Figs. 1 and 2, it will be noted that the lap D is, generally speaking, in the form of an axially elongated internal gear having its cylindrical body 1 formed with internal teeth 2. These teeth 2 are interrupted circumferentially by series of grooves 2^a, 2^a, which grooves are relatively narrow at the roots of the teeth 2 and widen toward the inner ends or crowns of the teeth.

When a spur gear is lapped in register with a lap of this character and by the method above described, it will be seen that the grinding effect on the sides of the gear teeth is progressively less from the roots of said teeth toward the crowns thereof than if the teeth of the lap were not grooved or cut away. The lap of this special form thus makes it possible to (1) true the teeth of gears which are too thick near their crowns or (2) reduce the thickness of the gear teeth near their crowns to a value less than the normal or true thickness.

By varying the form of the interruptions or grooves cut in the teeth of the lap various modifications of the lapping action may be secured. For example in Fig. 3 is shown a lap D′ having its longitudinal internal teeth 4 interrupted by a series of circumferential grooves 4^a which are wider near the roots of the lap teeth and gradually grow narrow towards the crowns of said teeth. Obviously the effect of grooves of this character is to lessen the grinding action of the lap upon the sides of the gear teeth near their crowns.

Various other modifications of lap teeth may be used and by predetermining the form of the lap any desired correction in the tooth form of the gear can be obtained. Thus, with our improved form of lap gear teeth of given contour can be modified to a predetermined contour as well as being corrected in spacing, with a minimum amount of lapping. In considering the action of the modified lap, it is to be borne in mind that the abrasive action is mutual, effecting the lap as well as the gear.

It will be understood that the forms of apparatus and the procedure herein set forth can be varied widely without departing from the invention as defined in the appended claims.

What we claim is:

1. An improvement in the art of truing toothed bodies such as gears, which consists in providing a toothed lap complementary to the body to be trued with its teeth spaced on a pitch circle substantially equal in diameter to the pitch circle of the body to be trued, the radial faces of which lap are partially cut away to an extent varying with the radial distance from the axis of the lap; assembling such toothed body and lap in concentric telescoping relation and causing relative axial travel between the lap and body while exerting a pressure in an angular direction to maintain abrasive contact between the radial faces of the body and lap.

2. An improvement in the art of truing toothed bodies such as gears, which consists in providing a toothed lap complementary to the body to be trued with its teeth spaced on a

pitch circle substantially equal in diameter to the pitch circle of the body to be trued, the radial faces of which lap are partially cut away to an extent varying with the radial distance from the axis of the lap; assembling such toothed body and lap in concentric telescoping relation and causing relative axial reciprocation between the lap and body while exerting a pressure in an angular direction to maintain abrasive contact between the radial faces of the body and lap; and during said reciprocation intermittently causing predetermined relative angular movement of the body and lap while they are out of mutual engagement and thereby changing the registration of the body and lap teeth.

In testimony whereof, we hereunto affix our signatures.

ALEXANDER W. COPLAND.
MAXWELL I. MATHEWSON.