

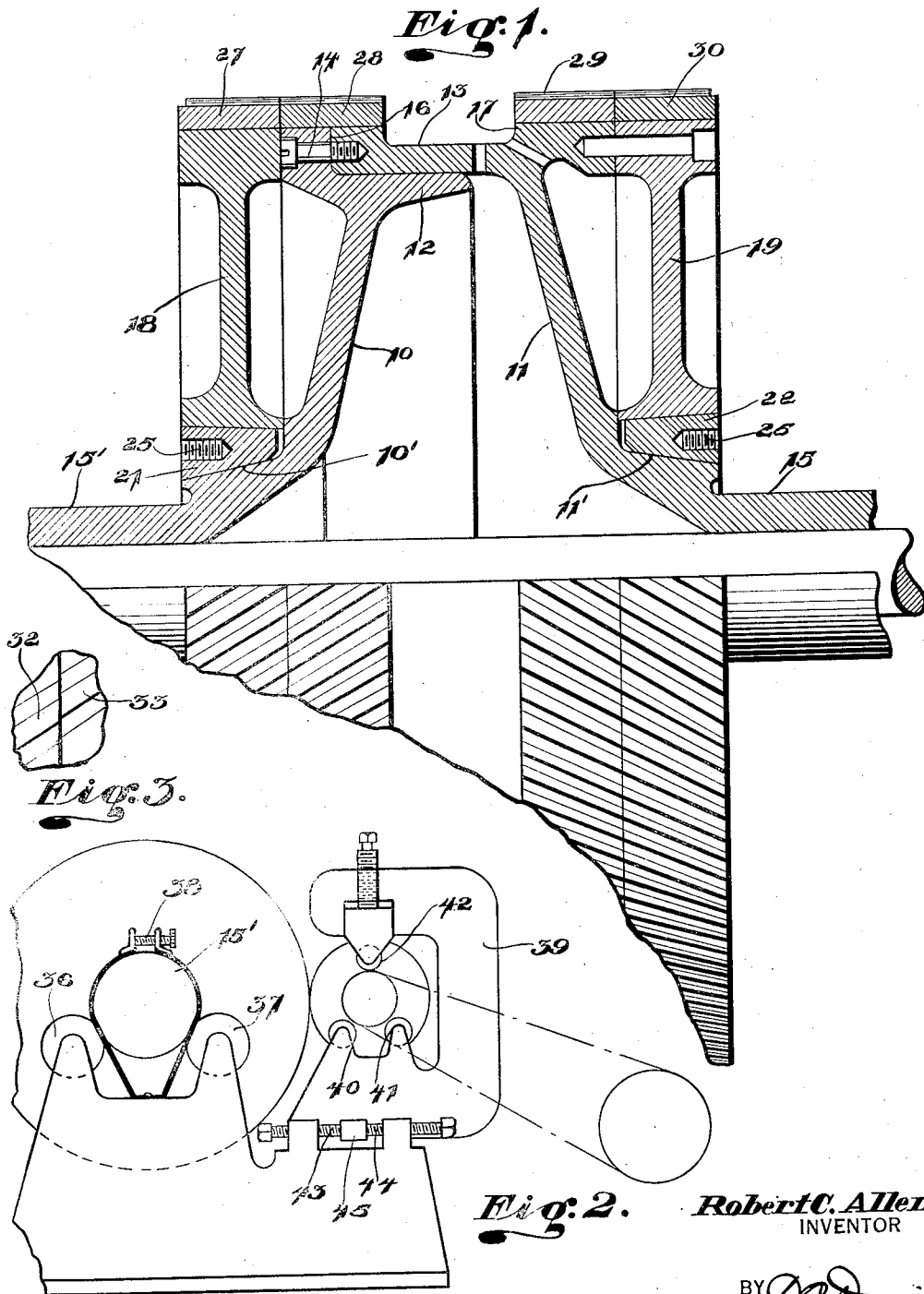
Dec. 9, 1924.

1,518,679

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PROCESS FOR FINISHING GEAR TEETH

Original Filed May 10, 1921



UNITED STATES PATENT OFFICE.

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PROCESS FOR FINISHING GEAR TEETH.

Original application filed May 10, 1921, Serial No. 468,295. Divided and this application filed December 6, 1922. Serial No. 605,265.

To all whom it may concern:

Be it known that I, ROBERT C. ALLEN, a citizen of the United States, and a resident of Essington, in the county of Delaware (and State of Pennsylvania, have invented a new and useful Improvement in Processes for Finishing Gear Teeth (which is a division of application Serial No. 468,295, filed May 10, 1921), of which the following is a specification.

My invention relates to a process for the manufacture of gears, more particularly of the high-speed and high-power type, such as marine reduction gears, and it has for its object to provide a method of manufacture which shall result in very accurate teeth.

Apparatus, whereby my improved method may be carried out, is illustrated on the accompanying drawings, forming a part of this application, in which Fig. 1 is a view, partly in section and partly in elevation, of a gear of a type suitable for the practicing of my improved method; Fig. 2 is an end elevation of a grinding rig for finishing gears in accordance with my improved method; and Fig. 3 is a detail view showing in an exaggerated way teeth of adjacent gear rims.

To secure the best operation with high-speed and high-power gearing, such as marine reduction gearing, it is necessary that the teeth shall be cut with the highest possible degree of accuracy. However, with the greatest of care and the most precise machinery for this purpose, small mechanical errors are inevitable. Accordingly, it is the object of my invention to construct a gear member having a row of teeth in at least two parts so that these parts may after a machining process be adjusted angularly with respect to each other until the position of maximum error in teeth is found. The maximum error may be determined by placing two teeth in exact alinement and noting the amount or extent of mis-alinement which occurs between corresponding teeth throughout the gear. Thereafter, the parts of the gear are so rotated relative to each other that the error is averaged or

divided between the parts and the gear is then placed in a rig and ground. In this way, the unavoidable errors involved in cutting are reduced.

In Fig. 1, I show a gear of a type suitable for employment of my improved method in finishing the teeth thereof. In this view, I show a main body portion or rotor comprising the rotor parts 10 and 11, having taper-fit flanges 12 and 13 and inwardly-extending webs provided with outwardly-extending hub portions 10' and 11', beyond which are the bearing portions 15' and 15.

The rotor or body portion parts 10 and 11 are held together, not only by the tightness of the taper fit of the flanges 12 and 13, but also by screws 14 passing through the rotor part 10 and having threaded engagement with the rotor part 11. Also, these rotor parts are held together by means of a gear rim 28, hereinafter more particularly referred to, which fits around radial flanges on the rotor parts 10 and 11, these flanges together defining a carrying portion 16 for the gear rim 28. The rotor is provided with a gear-rim carrying portion 17 at the other side for the gear rim 29.

Gear-rim carrying discs 18 and 19 are disposed about the hub portions 10' and 11', respectively, and they are provided with openings sufficiently larger than the hub portions to receive centering rings 21 and 22, the latter having openings 25, whereby the rings may be forced into place and removed by any suitable means.

The discs 18 and 19 carry gear rims 27 and 30 which are arranged adjacent to the gear rims 28 and 29, respectively.

Teeth are continuously cut in a gear-cutting machine across both laterally contacting gear rims 27 and 28, and teeth are cut in the same way across the laterally contacting gear rims 29 and 30.

Each helical row of teeth, made up of two adjoining gear rims, is divided in the manner referred to in order that my improved process of finishing the teeth to alleviate or to overcome small mechanical errors may be carried out. In order that my process of correction may be carried out, it

is necessary that the disc members 18 and 19 shall be rotarily adjusted with respect to the rotor parts 10 and 11, respectively. The openings in the disc members 18 and 19 as well as the hub portions 10' and 11' are bounded by surfaces of revolution, and these surfaces of revolution are inclined with respect to each other so as to receive the rings 21 and 22 which are conjugate thereto and are tapered in cross section.

After teeth are continuously cut across the pairs of gear rims 27, 28 and 29, 30, the gear is then ready for my improved method of finishing, whereby small mechanical errors are corrected for. This process will now be described. Considering the left-hand helical gear portion of Fig. 1, the centering ring 21 is removed or loosened and the disc 18 is rotated relatively to the rotor part 10 until the point of maximum error between the teeth on the gear rims 27 and 28 is found. The point of maximum error may be determined by placing a selected tooth of each of the rims 27 and 28 in exact alinement and noting the extent of the misalinement ensuing between corresponding teeth throughout the gear. The latter step will be apparent from Fig. 3, which shows in an exaggerated manner a tooth portion 32, which, on account of error in the previous machining process, varies in position from the tooth portion 33. The gear rim 27 and disc 18 are then rotated with respect to the rotor 10 so that the maximum distance between the mis-aligned teeth is reduced one-half, that is, the error is averaged or divided between the two gear rims. The right-hand helical gear portion, comprising the rims 29 and 30, is then adjusted in the same way. After these adjustments are made, the discs 18 and 19 are firmly secured in position to the rotor parts 10 and 11, respectively.

The gear is now ready for the grinding or finishing operation. It is placed in position in a rig such as shown in Fig. 2, having supporting rollers 36 and 37 for the journal portions 15 and 15' of the gear. Suitable braking means 38 is applied to one of the journal portions for a purpose to be more fully hereinafter set forth. The rig 35 is preferably provided with a suitable adjustable pinion-carrying member 39 which has lower bearing rollers 40 and 41 and an adjustable upper bearing roller 42 for the journal portion of a pinion. The pinion carrying member 39 is adjustable transversely of the rig by any suitable means such as the screws 43 and 44 which cooperate with lateral projections 45 carried by the base portion of the pinion-carrying member 39, the screws serving to secure both the transverse movement of the pinion-carrying member and the maintenance of the latter firmly in an adjusted position.

The pinion-carrying member 39 is so adjusted that the pinion may be caused to mesh with the gear-tooth portions of the gear rims aforesaid. Power is now applied to the pinion and the braking means 38 is rendered effective to resist rotation of the gear member. The gear and pinion are ground in the presence of an abrasive, for example, powdered emery, with a suitable lubricant, such as water or oil, until the tooth surfaces become smooth and continuous.

The operation of finding the point of maximum error is repeated a sufficient number of times until the error is reduced below the maximum allowable figure.

The pinion used for grinding the gear should have a number of teeth that has no factor evenly divisible by the number of teeth on the main gear, that is, a hunting tooth should be provided. The pinion may be relatively large in order that it may be used several times without material change in tooth shape.

As the gear rims are ground until the division angle and the surfaces of the teeth possess the desired degrees of accuracy, the actual pinion that is to be used with the gear being corrected may now be ground to the corrected gear without injury to the latter or the pinion may be treated by grinding separately with a carefully corrected wheel and given only a smoothing rub in the presence of an abrasive with the gear with which it is to be used.

While I have shown my invention in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various other changes and modifications, without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are imposed by the prior art or as are specifically set forth in the appended claims.

What I claim is:—

1. A process of making and finishing gears which consists in placing a plurality of gear blanks side by side and in axial alinement, cutting thereon tooth portions running continuously across the blanks rotatively adjusting one cut blank with respect to another until the point of maximum error is found, further relatively adjusting the blanks to average the error among the teeth, and finishing the gears while so adjusted.

2. A process of making and finishing gears which consists in placing a plurality of gear blanks side by side and in axial alinement, cutting thereon tooth portions running continuously across the blanks, rotatively adjusting one cut blank with respect to another until the point of maximum error is found, further relatively adjusting

the blanks to average the error among the teeth, and grinding the teeth by means of meshing teeth in the presence of an abrasive.

3. A process of making and finishing gears which consists in placing a plurality of gear blanks side by side and in axial alinement, cutting thereon tooth portions running continuously across the blanks, rotatively adjusting one cut blank with re-

spect to another until the point of maximum error is found, further relatively adjusting the blanks to average the error among the teeth, applying braking means to the gear, and rotating the latter by another gear in the presence of an abrasive. 15

In testimony whereof, I have hereunto subscribed my name this 28th day of November, 1922.

ROBERT C. ALLEN.