A. JOHNSTON.

METHOD OF MAKING SHEET METAL GEARING.

APPLICATION FILED MAY 27, 1909.

988,106. Patented Mar. 28, 1911.

Fig. 1.

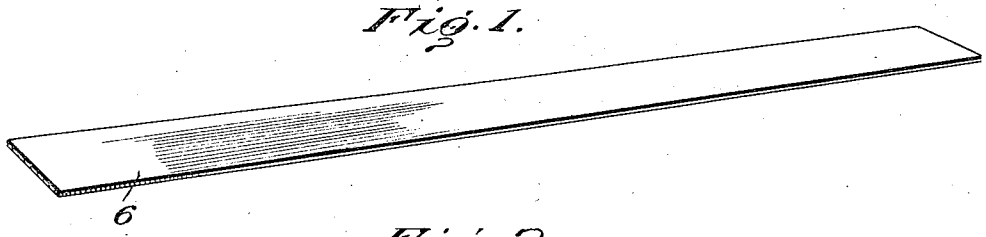


Fig. 2.

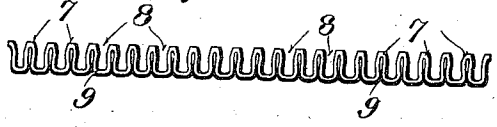


Fig. 3.



Fig. 4.

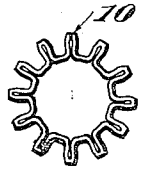


Fig. 5.

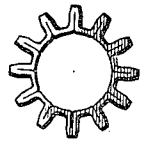


Fig. 6.

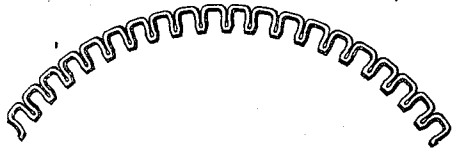
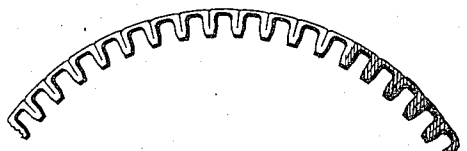


Fig. 7.



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UNITED STATES PATENT OFFICE.

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METHOD OF MAKING SHEET-METAL GEARING.

988,106. Specification of Letters Patent. Patented Mar. 28, 1911.

Application filed May 27, 1909. Serial No. 498,732.

To all whom it may concern:

Be it known that I, ALLEN JOHNSTON, of Ottumwa, Iowa, have invented a new and useful Improvement in Methods of Making Sheet-Metal Gearing, which invention is fully set forth in the following specification.

This invention relates to a method of making sheet-metal gearing, and has for its object to provide a method whereby gearing of this kind may be cheaply and expeditiously manufactured, and of a superior quality.

With this object in view the method consists in taking a strip of sheet-metal, as for example sheet-steel, of any desired thickness and width and then crimping said strip so as to provide it with a series of regularly formed and spaced crimps to form the teeth of the gearing. This crimping action may be performed in any suitable manner and by any suitable means, preferably, however, by the action of the improved crimping machine set forth in my U. S. Patent, No. 944,559, dated December 28, 1909. In forming crimps which are to constitute the teeth of the gearing, the metal is bent at the crown of the teeth or crimped sharply upon itself so as to bring two faces of the metal closely adjacent to each other, the crimping action being such as to form the teeth approximately alike and with approximately uniform spaces intervening between the teeth. The strip thus crimped forms an effective gearing for certain classes of work without any additional treatment, but where accuracy and strength of the teeth are required, the gearing is greatly improved by subjecting the same to pressure in a suitable die whereby the teeth are forcibly compressed, preferably in the manner of cold forging, so that the teeth are rendered absolutely true and uniform with the adjoining surfaces of the metal constituting each tooth brought into intimate contact throughout the whole or a part of their extent, thereby greatly stiffening the tooth and rendering it rigid, and also truing the spaces between the teeth so that the smoothness of finish, regularity of form of the teeth and the spaces, and the rigidity and accuracy of the entire gear, is greatly enhanced over that found in the gearing formed by the original crimping action.

The crimped strip, either before or after the cold forging in the die to accurately shape the teeth and spaces, may be used for the various forms and varieties of gearing known to the art. Thus, a strip may be used as a rack, or it may be bent into annular form and the ends of the strip preferably joined together by welding, soldering, or other suitable means, to form either an external or internal gear-wheel. The accurate shaping, whether said operation is performed by cold forging or other suitable means, may be performed before or after the strip is bent into annular form with its ends united, as indicated above. Preferably, however, this operation is performed (when the gearing is to assume the form of a gear-wheel) after the crimped strip has been bent into annular form and the ends thereof secured together.

It will, of course, be understood that the distance from center to center of the crowns of adjoining crimps in the crimped strip before it is bent into annular form to make a gear-wheel differs from the distance from the center of the crown of one tooth to the center of the crown of the adjoining tooth in the wheel constructed from such crimped strip, and, therefore, when crimping a strip to construct a gear-wheel of given pitch and with a given number of teeth, it is essential that the crimps of the strip should be formed at such a distance apart that when bent into annular form to construct a gear-wheel the crimps forming the teeth of the gear-wheel will have the desired pitch. Thus, if it be desired to construct an external toothed gear-wheel of 14 pitch with 115 teeth the distance from center to center of the crowns of the crimped strip should be .210 of an inch. If the wheel is to be one of 120 teeth and 14 pitch, the distance from center to center of the crowns in the strip should be .215 of an inch, and if a wheel is to be constructed of 125 teeth and 14 pitch, the crowns in the strip should be .220 of an inch from center to center. It will be observed that in each of these instances this distance from center to center of the crowns of the crimps is less than would be the distance from center to center of the crowns of the teeth of a wheel of the kind indicated. These examples will illustrate the principle indicated above that the distance from center to center of the crowns of the crimped strip should differ slightly from the distance from center to center of the crowns of the teeth in the construction of which the crimped strip is designed to enter. The

proper distances from center to center of the crimps may be readily computed for any desired pitch and for a wheel of any desired number of teeth.

When the gearing assumes the form of a gear-wheel, the annular crimped strip of metal may be mounted directly on a shaft, or, if preferred, may be mounted on a suitable body portion composed either of sheet-metal, as set forth in my U. S. Patent No. 951,503, dated March 8, 1910, or on any other suitable body.

The method of constituting the invention may be practiced by the use of a variety of forms of tools and apparatus, the particular tools for crimping, shaping, forging and uniting the ends of the strips, etc., forming no part of the invention.

For the purpose of illustrating the invention, reference is had to the accompanying drawings, which drawings, however, are employed merely for purposes of illustration and not for the purpose of defining the limits of the invention, reference being had to the claims for this purpose.

In said drawings—Figure 1 represents a strip of sheet-metal, as of sheet-steel or sheet-brass, of any suitable or desired width and thickness; Fig. 2 is a side elevation of said strip after the same has been crimped and before the teeth have been shaped by cold forging or otherwise; Fig. 3 shows the condition of said crimped strip after it has been shaped by cold forging or other treatment under pressure; Fig. 4 shows the crimped strip of Fig. 2 bent into annular form with its ends united to form an external gear-wheel; Fig. 5 shows the gear-wheel of Fig. 4 after it has been shaped under pressure, preferably by cold forging; Fig. 6 shows a section of an internal gear-wheel before the same is shaped; and Fig. 7 shows a section of an internal gear-wheel after truing or shaping.

Referring to the drawings, 6 (Fig. 1) indicates a plain strip of sheet-metal of any desired length, width and thickness. This strip of sheet-metal is suitably crimped by the use of a proper crimping machine, or other apparatus, into the shape shown in Fig. 2, the crimps 7 being only approximately uniform, as are also the spaces 8 between the crimps, and with the adjoining surfaces of that portion of the metal constituting each tooth, as indicated at 9, very nearly or quite contacting. By the use of a suitable crimping apparatus it is possible to bring the surfaces 9 into actual contact and to form the teeth 7 and the spaces 8 of a very considerable uniformity, so much so, in fact, that the crimped strip as crimped, and without any additional operation of shaping the teeth and spaces by cold forging or otherwise, may be employed as a gearing either in the form of a rack or gear-wheel, or any other suitable or desired form of gearing. In general practice, however, and for the better forms of gearing, it is found desirable to accurately shape the teeth 7 and the spaces 8 by subjecting the same to pressure, and this is accomplished by subjecting the same to the action of a die under pressure, preferably when cold, so that the crimped strip is really cold forged, the action of the die being to bring the adjacent surfaces at 9 into intimate contact with each other throughout the whole or a part of their extent and to shape each of the teeth 7 so that they are alike, and to likewise form the spaces 8 so that they are alike, as clearly shown in Fig. 3, thus providing a gearing which will be perfectly true and accurate in operation. In addition to this the compacting of the metal forming the teeth of the gear renders said teeth perfectly rigid, and eliminates any elasticity that would reside in the crimped teeth where the surfaces 9 were not in intimate contact.

The crimped strip, as shown in Fig. 2, may be formed into a gear-wheel by bending the same into annular form and uniting the ends of the strip in any suitable manner, as by soldering or by welding, as shown at 10 in Fig. 4. This forms a gear-wheel with approximately uniform teeth 7 and spaces 8 which may be used in certain rough forms of machinery, but to form a true and accurate gear-wheel the annular gear-wheel of Fig. 4 is subjected to a truing operation by the use of any suitable apparatus. Preferably, this is performed by cold forging the wheel of Fig. 4 by the use of suitable dies, though the truing action is not necessarily limited to cold forging by dies, since any desired or convenient apparatus for accomplishing this end may be employed.

While it is indicated above that the truing operation on the gear-wheel is performed after the same has been bent into annular form and the ends united together, it is not to be understood that the invention is limited to performing the truing action after the bending of the crimped strip, since, if desired, the teeth 7 and the spaces 8 may be trued, as by cold forging, or otherwise, while the same is in the form shown in Fig. 2, thus producing the trued crimped strip of the form shown in Fig. 3, and this trued strip then bent into annular form to produce the perfected and accurate gear-wheel of Figs. 5 or 7. Preferably, however, the crimped strip of Fig. 2 is first bent into the annular form shown in Fig. 4, the ends of the strip then united as by welding, cold soldering, or otherwise, and the same then trued as by cold forging, or otherwise, into the completed gear-wheel of Figs. 5 or 7.

The gear-wheel of Fig. 4, or the trued wheel of Fig. 5, may be mounted on any suitable body, either solid, or formed with

spokes and a suitable rim, as desired, or it may be keyed directly to a suitable shaft, or otherwise secured thereon.

It will be apparent that the invention is equally applicable to plain or beveled gearing.

Obvious changes in the specific details herein described which will not involve departure from the inventive idea of the method set forth will suggest themselves to the skilled mechanic, and such obvious changes are designed to be within the scope of the patentee's claims.

Having thus described the invention, what I claim is—

1. The process of making sheet-metal gearing, which consists in crimping a strip of sheet-metal into gear-teeth with the adjacent surfaces of the sheet-metal on the inner side of each tooth approximately contacting, and then bringing said adjacent surfaces into intimate contact under pressure.

2. The process of making sheet-metal gearing, which consists in crimping a strip of sheet-metal into gear-teeth with the adjacent surfaces of the sheet-metal on the inner side of each tooth approximately contacting, and then subjecting said teeth to a cold-forging operation to bring said adjacent surfaces into contact and to stiffen and accurately space the same.

3. The process of making sheet-metal gearing, which consists in crimping a strip of sheet-metal into gear-teeth with the adjacent surfaces of the sheet-metal on the inner side of each tooth approximately contacting, and then bringing said adjacent surfaces into intimate contact by cold forging.

4. The process of making sheet-metal gearing, which consists in crimping a strip of sheet-metal to form rough gear-teeth approximately alike with the adjacent surfaces of the sheet-metal forming each tooth approximately contacting, then bending said crimped strip into annular shape to form a gear-wheel, and bringing said surfaces into intimate contact by cold forging.

5. The process of making sheet-metal gearing, which consists in crimping a strip of sheet-metal to form rough gear-teeth approximately alike, bending the crimped strip into annular shape to form a gear-wheel, uniting the ends of said strip, and then accurately shaping said teeth and the intervening spaces under pressure.

6. The process of making sheet-metal gearing, which consists in crimping a strip of sheet-metal to form rough gear-teeth approximately alike, bending the crimped strip into annular shape to form a gear-wheel, uniting the ends of said strip, and then accurately shaping said teeth and the intervening spaces by cold forging.

7. The process of making sheet-metal gearing, which consists in crimping a strip of sheet-metal to form rough gear-teeth approximately alike, bending the crimped strip into annular shape to form a gear-wheel, uniting the ends of said strip, and bringing the adjacent surfaces of the sheet-metal forming each tooth into intimate contact by cold forging.

8. The method of making sheet-metal gearing, which consists in crimping a strip of sheet-metal so as to provide it with a series of approximately alike and approximately uniformly spaced crimps or teeth, cutting from said crimped strip a portion having a number of crimps corresponding to the desired number of teeth in a gear wheel to be made, bending said severed portion into approximately annular form, uniting the adjacent ends and then truing the teeth simultaneously by bringing the adjacent surfaces of the sheet-metal forming each tooth into intimate contact under pressure to reduce them to exact uniform size and pitch.

9. The process of making sheet-metal gearing, which consists in crimping a strip of sheet-metal into gear-teeth with the adjacent surfaces of the sheet-metal on the inner side of each tooth approximately contacting and then bending said crimped strip below the pitch line into an annular shape to form a gear-wheel, at the same time increasing the distance from center to center of the teeth on the pitch line.

10. The process of making sheet-metal gearing, which consists in crimping a strip of sheet-metal into gear-teeth with the adjacent surfaces of the sheet-metal on the inner side of each tooth approximately contacting and then bending said crimped strip below the pitch line into an annular shape to form a gear-wheel, at the same time changing the distance from center to center of the teeth on the pitch line.

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

ALLEN JOHNSTON.

Witnesses:
R. W. FENCH,
F. A. WRIGHT.