A. L. STEWART & F. E. McMULLEN.

GEARING.

APPLICATION FILED JUNE 28, 1917.

1,295,231.

Patented Feb. 25, 1919.

2 SHEETS—SHEET 1.

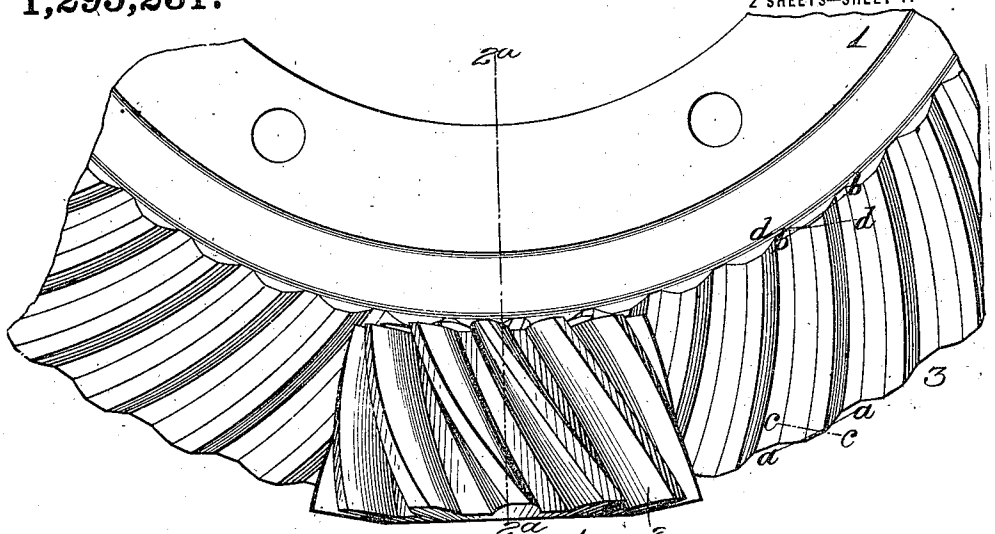


Fig. 1

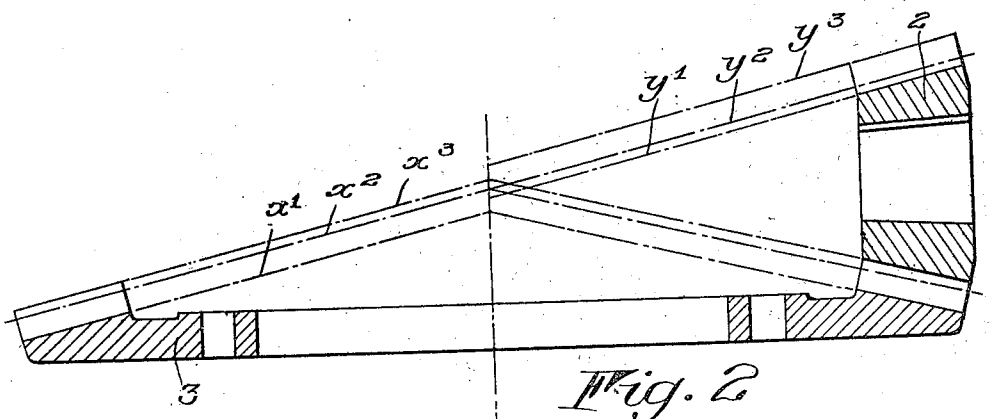


Fig. 2

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2 SHEETS—SHEET 2.

Fig. 3

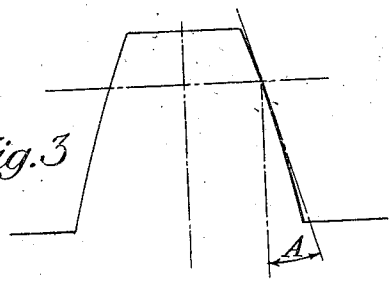


Fig. 4

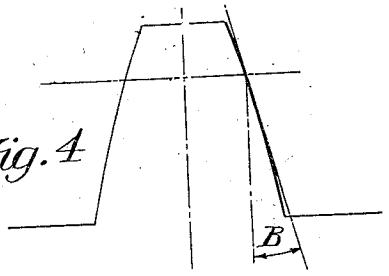


Fig. 5

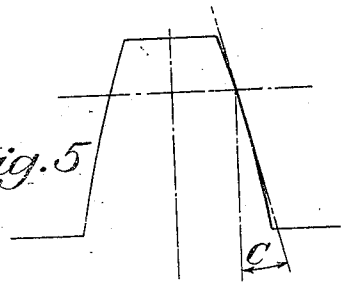


Fig. 6

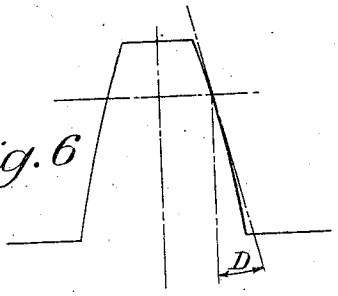


Fig. 7

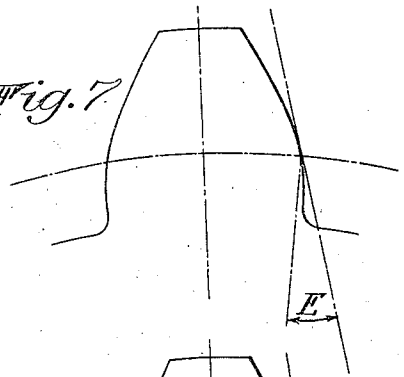


Fig. 8

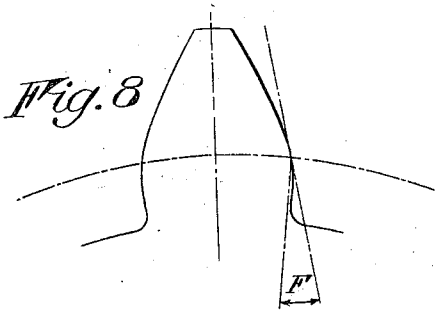


Fig. 9

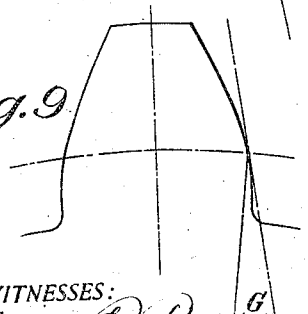
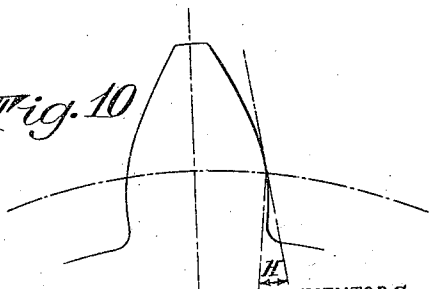


Fig. 10



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UNITED STATES PATENT OFFICE.

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GEARING.

1,295,231. Specification of Letters Patent. Patented Feb. 25, 1919.

Application filed June 28, 1917. Serial No. 177,567.

To all whom it may concern:

Be it known that we, ARTHUR L. STEWART and FREDERICK E. McMULLEN, both of Rochester, in the county of Monroe and State of New York, have invented certain new and useful Improvements in Gearing; and we do hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming a part of this specification, and to the reference characters marked thereon.

The invention relates to gearing, being especially applicable to bevel gears and pinions, and has for its purpose to so construct a mating gear and pinion as to afford quiet running and permit a practicable range of adjustment between the gear and pinion, while at the same time allowing for greater error in alining the members of the pair than with other forms of beveled gears. To these and other ends the invention consists in certain improvements and combinations of parts all as will be hereinafter more fully described, the novel features being pointed out in the claims at the end of the specification.

In the drawings:

Figure 1 is a plan view of a pinion and gear made according to our invention, the gear being partially broken away;

Fig. 2 is a sectional view on line 2^a—2^a of Fig. 1;

Fig. 3 is an end elevation of a tooth of the gear looking at the large end;

Fig. 4 is a similar view looking at the small end of the tooth;

Fig. 5 is a diagrammatic view of a section of a tooth of the gear taken at the large end in a direction normal to the longitudinal tooth curve, as on line *c*—*c* of Fig. 1;

Fig. 6 is a similar view at the small end of the tooth, as on line *d*—*d* of Fig. 1;

Fig. 7 is a view in end elevation of a tooth of the pinion at the large end;

Fig. 8 is a similar view of a pinion tooth at the small end;

Fig. 9 is a diagrammatic view of a tooth of the pinion at the large end on a section normal to the longitudinal tooth curve, and

Fig. 10 is a similar view taken on a section normal to the longitudinal tooth curve at the small end of the tooth.

Similar reference characters in the several figures indicate the same parts.

Our invention is associated with the class of gearing known generally as spiral, and sometimes referred to as worm bevel gearing where applied to bevels, but irrespective of the term under which the gear may be denominated, it includes generally, and may be applied to, any form of gear and pinion in which the teeth of the pair are curved lengthwise, or from one end to the other. This curve may be of any character, although preferably determined by a circular arc, since this is the curve which lends itself most readily to producing a curved tooth, as it permits sweeping a tool continuously in a circular path about a central axis.

The teeth of both the gear and pinion are of generated shape, and in using the term "generated" throughout this description and the claims following, it is the purpose to include any tooth, the profile or vertical curve of which is that of a true involute, or of an octoid, as in the case of bevel gearing, where the tooth is shaped by a tool representing a crown gear tooth having a flat or straight side. The octoidal curve is a close approximation to a true involute, and has been adopted to obtain the result in bevel gears, owing to the difficulty in practically making a cutting tool with the involute curve that a crown gear tooth possesses. Irrespective of whether the curve is octoidal or involute, the underlying important consideration is that the tooth shall have what is known as a generated shape, resulting from shaping the tooth by a cutting motion, while simultaneously effecting relative generating or rolling motion between the tool and the gear blank, corresponding to the relative motion that takes place when the blank is rolled upon a rack, or crown gear, or bevel gear, as the case may be. A further characteristic of the present invention resides in having the teeth of both the gear and pinion of the same depth from one end to the other, the base, pitch and face surfaces of the teeth being parallel.

1 designates the gear of the pair, and 2 is the pinion, which will be clearly seen from Figs. 1 and 2, showing the longitudinal curvature of the teeth. The curve of the teeth from end to end is preferably that of a circle, although some other curve may be utilized, if preferred, such as a logarithmic spiral. The base surface of the gear is designated by x' in Fig. 2, the pitch surface by

x^2 and the face surface by x^3, and the corresponding surfaces of the pinion are designated by y', y^2 and y^3. The depth of each tooth on the gear and pinion is the same at both ends, the pitch surfaces, face surfaces and base surfaces all being parallel.

The cross sectional shapes, or profiles of the gear and pinion are illustrated in Figs. 3 to 10 inclusive, where Figs. 3 to 6 refer to the gear, and Figs. 7 to 10 refer to the pinion. The large ends of the teeth of the gear and pinion respectively are shown in Figs. 3 and 7, whereas the small ends of the same teeth are shown respectively in Figs. 4 and 8. The large ends of the teeth of the gear and pinion on sections which are normal to the longitudinal curve of the tooth are shown in Figs. 5 and 9, while the small ends on similar sections are shown in Figs. 6 and 10. The pressure angle at sections normal to the tooth curve is the same at all points for both the gear and pinion. This will be observed from Figs. 5, 6, 9 and 10, where angles C and D, G and H are all equal, whereas the pressure angles upon circular or concentric sections change with any variation in the angle of curvature. In the case of an equiangular spiral, the pressure angle on concentric sections would be the same at all points, but where a circular curve is adopted, the pressure angle changes slightly from one end of the tooth to the other, as illustrated by the difference between angles A and B, and between angles E and F. The pressure angles on circular or concentric sections for a meshing gear and pinion are the same at points equally distant from the cone center of the pair, since the angle of curvature of the two members of the pair is the same at such points. Thus angles A and E are equal, and likewise B and F.

We claim as our invention:

1. A coöperating bevel gear and pinion in which both members of the pair have tapered generated teeth that are curved lengthwise and are of equal depth throughout their lengths.

2. A coöperating bevel gear and pinion in which both members of the pair have tapered generated teeth that are curved lengthwise on circular arcs and are of equal depth throughout their lengths.

3. A coöperating bevel gear and pinion in which both members of the pair have tapered octoidal shaped teeth that are curved lengthwise and in which the face, root and pitch surfaces are parallel.

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