(No Model.)

C. C. TYLER.

MILLING CUTTER.

No. 551,064. Patented Dec. 10, 1895.

Fig. 1.

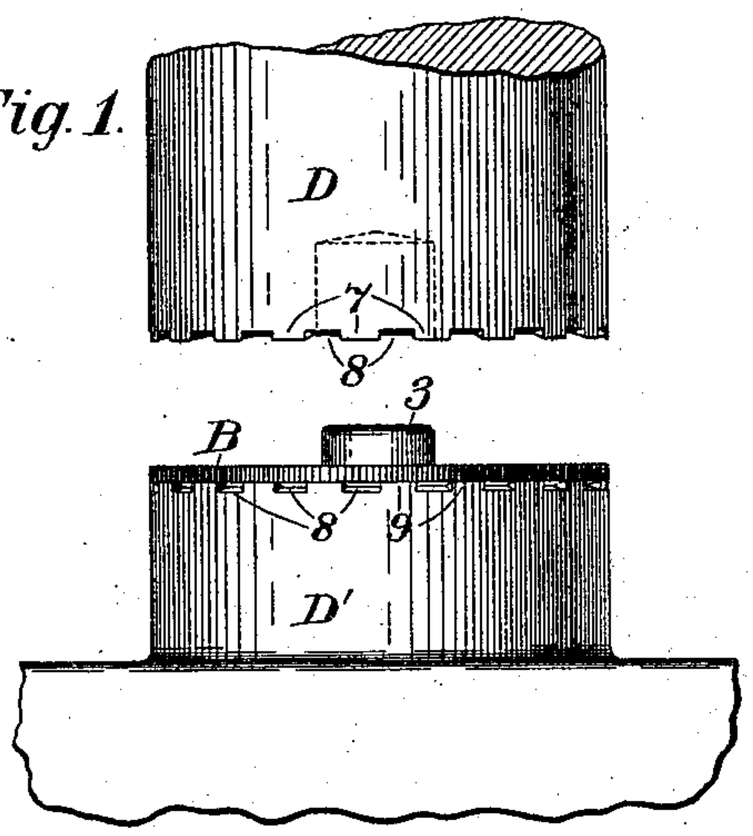


Fig. 2.

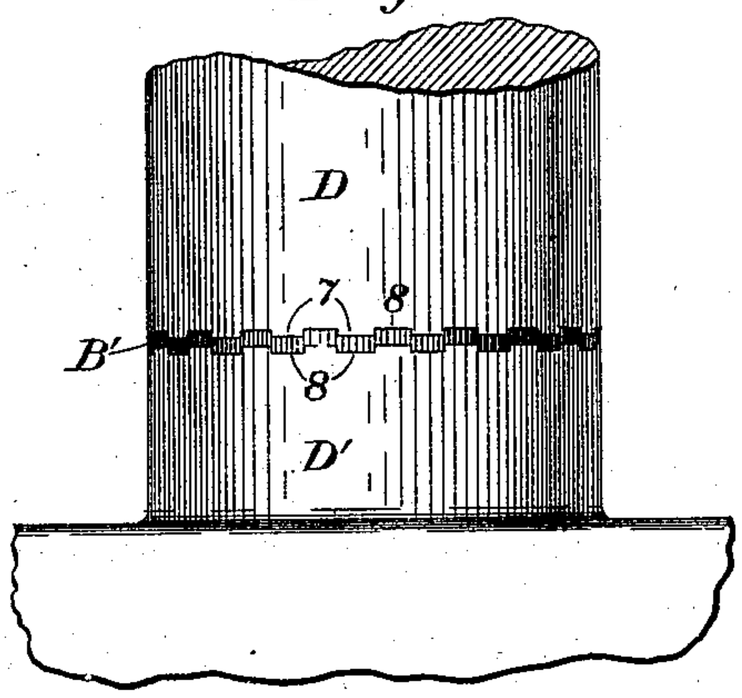


Fig. 4.

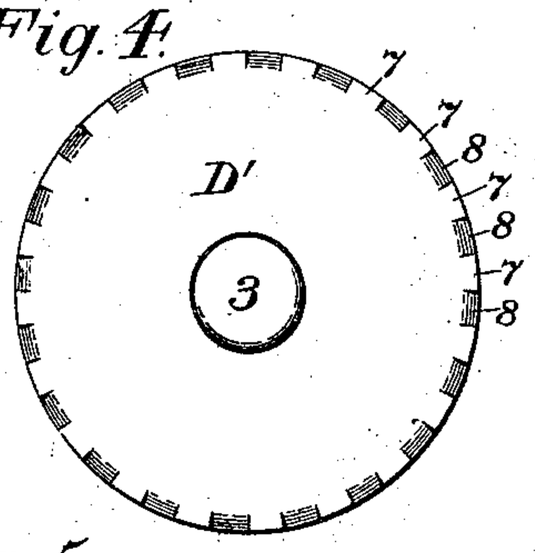


Fig. 3.

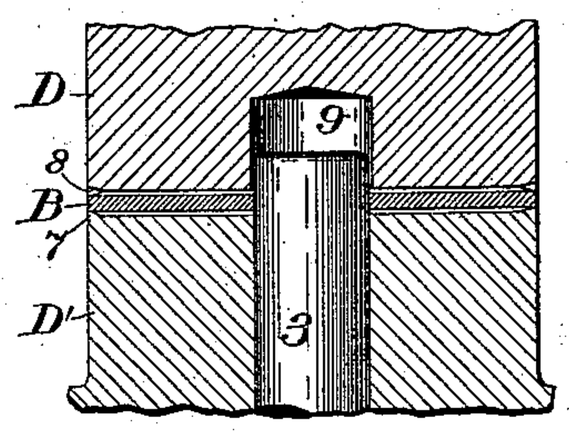


Fig. 5.

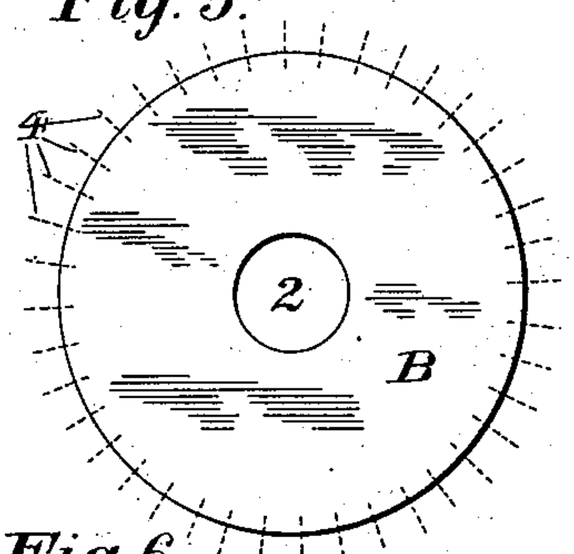


Fig. 6.

Fig. 7.

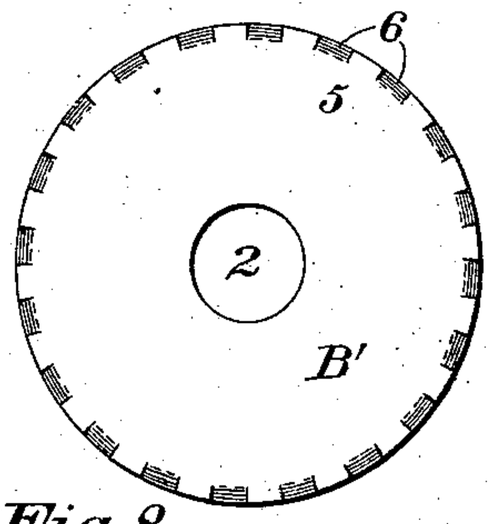


Fig. 8.

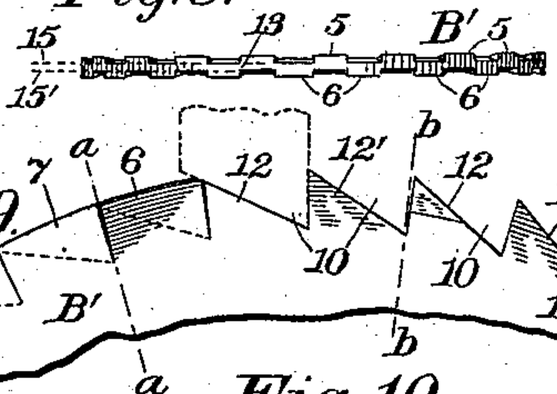


Fig. 9.

Fig. 10.

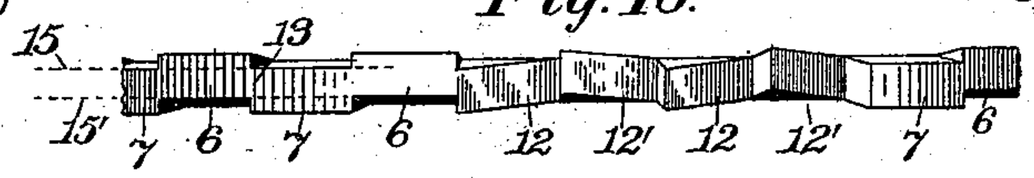
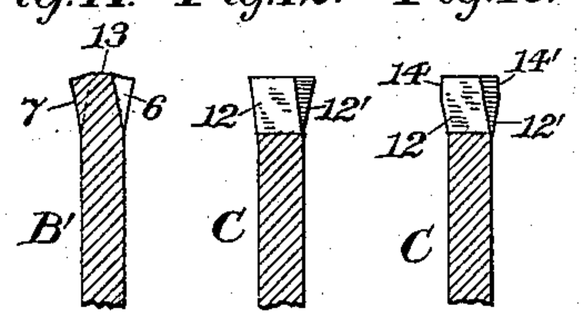


Fig. 11. *Fig. 12.* *Fig. 13.*



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UNITED STATES PATENT OFFICE.

CHARLES C. TYLER, OF HARTFORD, CONNECTICUT.

MILLING-CUTTER.

SPECIFICATION forming part of Letters Patent No. 551,064, dated December 10, 1895.

Application filed January 28, 1895. Serial No. 536,443. (No model.)

To all whom it may concern:

Be it known that I, CHARLES C. TYLER, a citizen of the United States, residing at Hartford, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Milling-Cutters, of which the following is a specification.

This invention relates to the manufacture of cutters, and has particular reference to the manufacture of that class of cutters commonly known as "side-milling" cutters or "face mills."

The object of my present invention is, primarily, to furnish a cutter-blank for cutters of the class specified having two sets or two series of circumferential tooth-blank portions, adapted to be peripherally notched or milled to form successive relieved teeth with chip-spaces intermediate thereto, and in which the tooth-blank portions of one set are bent sidewise in opposition to and alternate with the tooth-blank portions of the other set, and in which the alternating tooth-blank portions are peripherally contiguous and project in opposite directions, respectively, beyond the side faces of the cutter-blank, as will be hereinafter fully described.

Another object of my invention is to furnish an improved apparatus whereby a flat metallic blank may have successive tooth-blank forming portions or segments, at or near the periphery thereof, bent or swaged in opposite directions, in alternating order, crosswise of the peripheral line of and from opposite sides of said blank, to thereby produce a cutter-blank having two sets of tooth-blank portions, which are staggered or offset in opposite directions, crosswise of the blank alternately, and which are adapted to be subsequently peripherally notched or milled to form successive relieved cutter-teeth with chip-spaces intermediate thereto.

In the drawings accompanying and forming a part of this specification, Figure 1 is a side elevation of one form of the apparatus adapted for producing cutter-blanks of the class specified, said figure showing two swaging members with a plain untoothed cutter-blank intermediate thereto and in position to be swaged into the form shown in Fig. 7, said figure also showing members in the position they occupy preparatory to the swaging operation. Fig. 2 is a side elevation of the apparatus shown in Fig. 1, showing the swaging members in the position they occupy after a blank has been swaged between them. Fig. 3 is a longitudinal section of a portion of the two members, showing a plain untoothed blank between them. Fig. 4 is a plan view of the lower swaging member or die. Fig. 5 is a face view of a plain untoothed discoidal blank before it has been acted upon by the swaging members shown in Figs. 1 and 2 to form tooth-blank portions in opposite faces at or near the periphery thereof. Fig. 6 is a cross-section taken through the center of the blank shown in Fig. 5. Fig. 7 is a face view of a cutter-blank having two sets of oppositely-disposed circumferential tooth-blank portions, one set alternating with those of the other set, which blank is the result of the swaging of the blank shown in Fig. 5 as effected by the apparatus shown in Figs. 1 and 2. Fig. 8 is an edge view of the cutter-blank shown in Fig. 7. Figs. 9 and 10 are side and edge views, respectively, on an enlarged scale, of a portion of a partially-finished cutter of the class specified, Fig. 9 showing in dotted lines a cutter or tool in position for cutting the chip-spaces in the periphery of the cutter-blank and for truing the cutting-edges of the teeth so formed. Fig. 11 is a cross-sectional view of the swaged cutter-blank, taken in dotted line *a a*, Fig. 9, and showing the relative positions of two adjacent tooth-blank portions before the cutting-edges thereof are brought into parallelism by the subsequent chip-space-forming operations. Fig. 12 is a similar view taken in dotted line *b b*, Fig. 9, showing two adjacent cutter-teeth after their cutting-edges have been brought into parallelism and trued by the chip-space-forming operation; and Fig. 13 is a similar cross-sectional view of a portion of a finished cutter, showing the opposite sides of the two adjacent teeth ground off to bring the opposite side faces of the adjacent oppositely-disposed teeth at their cutting ends into parallelism with the side faces of the cutter and to bring the side faces of all of the alternating teeth into alignment.

Similar characters represent like parts in all the figures of the drawings.

In the drawings only so much of one form of apparatus for making cutter-blanks of the

class specified is shown as is deemed necessary to clearly illustrate the manufacture of such blanks.

In the manufacture of milling-cutters of the class specified I employ, preferably, a plain flat discoidal blank, as B, of a diameter substantially or approximately coinciding with the diameter of the finished cutter to be made from said blank and having an axial recess or centering-opening 2, adapted for receiving the centering-pin or positioning-pin (as shown in Figs. 1 and 3 and designated by 3) of the swaging apparatus, which apparatus will be hereinafter fully described.

As distinguished from the invention of forming teeth or serrations in the opposite faces of blanks by means of dies by compression—as set forth, for instance, in my prior application, Serial No. 536,171, filed January 25, 1895—the successive circumferential tooth-blank-forming portions of the blank B are not subjected to compression, but merely have the angles of their faces changed relatively to each other and relatively to the side faces of the cutter-blank, adjacent tooth-blank-forming portions being bent, respectively, in opposite directions crosswise of said blank.

By the term "peripheral tooth-blank-forming portions," as applied to the plain discous blank B, are meant those segments at the periphery of said blank intermediate to the radial dotted lines designated by 4 in Fig. 5 of the drawings. The two opposing sets of tooth-blank portions of the swaged blank (designated by B′) are shown most clearly in Fig. 7 of the drawings, and are designated, the tooth-blank portion of one set by 5 and the tooth-blank portions of the other set by 6.

As an instrumentality for the manufacture of my improved milling-cutters of the class specified I usually employ two cutter-blank-swaging members, as shown in Figs. 1, 2, and 3 of the drawings, and designated by D and D′, respectively. These swaging members, which are, as shown in Figs. 1 and 2, constructed and adapted for co-operation as complementary dies, have substantially similar tooth-blank-swaging working faces—that is to say, the working face of each die has a circuit of alternating and corresponding tooth-blank-forming projections 7 and tooth-blank-forming indentations 8, and said dies will be so disposed in an operative relation that the tooth-blank-forming projections 7 upon the working face of one die will be complementary to and will coact with the tooth-blank-forming indentations 8 in the other die. Thus it will be seen that when the two dies D and D′ are pressed toward each other and against the opposite sides of a plain blank, as B, which is held between the working faces thereof, the coacting tooth-blank-forming projections and indentations of one die will coact with the indentations and projections, respectively, of the other die and swage or bend the successive tooth-blank-forming portions of the blank B to bring the same to the form shown in Figs. 2, 4, and 8 of the drawings, with adjacent tooth-blank portions 5 and 6 bent sidewise in opposite directions, respectively. The tooth-blank-forming projections and indentations upon and in the face of each die will in practice, as shown in Fig. 3, be somewhat V-shaped in longitudinal section, or a section taken in a line radiating from the axis of said die. It will be understood, however, that the contour of said tooth-blank-forming projections may be varied without departing from my present invention.

As a means for holding the untoothed cutter-blank against distortion at the middle portion thereof during the operation of swaging or bending the peripheral tooth-blank-forming portions, and at the same time effecting a truing or straightening of the middle portion of said blank, the two swaging-dies D and D′ have the middle portions of the working ends thereof (or those portions intermediate to and within the circuits of the bights or tooth-blank-forming rims) in relatively parallel planes coinciding with the planes of the two side faces of the blank, and said plane faces are adapted, as will be understood by comparison of Figs. 1, 2, and 3 of the drawings, for engaging the opposite side faces, respectively, of the blank and for pressing the middle portion of said blank between said plane faces at or near the completion of the working stroke of the die D, thereby effecting an accurate truing and peripheral alignment of said blank. It will be understood that the die D will be so limited in its working stroke as to compress the middle portion of the blank to an extent only sufficient to bring the opposite faces thereof into true parallelism without peripheral expansion. This is a matter of considerable importance in the manufacture of circular milling-cutters of the class specified, as it obviates the necessity of a subsequent truing operation, as would be necessary if no means were provided for sustaining the middle portion of the blank against distortion during the operation of bending the peripheral tooth-blank-forming portions of said blank, as such bending or swaging operation at the periphery of said blank would have a tendency to laterally distort the middle portion of the blank or cause the same to buckle.

The dies or tooth-blank-forming members may, if desired, be used in connection with an ordinary drop-press, and one of said dies, herein shown as the lower die D′, will be provided with a centering-pin, as 3, adapted for entering the axial recess in the blank B and for preventing displacement of said blank while being operated upon by the dies. In the present instance the pin 3 is shown (see Fig. 3) seated in an axial recess in the lower die D′, with its end projecting beyond the working face of said die in position to enter the axial recess 8 in the upper die D. This

pin also positions the upper die relatively to the lower die, so as to prevent transverse movement of one die relatively to the other.

To secure the highest degree of precision and efficiency in cutters of the class specified, having staggered teeth, substantially as described, and to thereby adapt them for high-grade work, it is of material importance that the peripheral cutting-edges of the teeth 12 and 12′ of said cutter shall be truly parallel with one another and in a plane parallel to the axis of said cutter. To accomplish this, it is desirable that the blank B shall have the tooth-blank-forming portions thereof swaged, as hereinbefore described, without breaking the continuity of the middle portion of the periphery of the blank to form the successive tooth-blanks 6 and 7, bent sidewise, respectively, in opposite directions, and subsequently removing, by milling or otherwise, a portion of each tooth-blank to form peripheral relief or chip spaces 10, which milling operation also trues the cutter-teeth, bringing their cutting-edges into parallelism. These operations, in the respective order described, take precedence in practicability over the same operations if the order thereof was reversed, for the following reasons, to wit: By swaging the cutter-tooth-blank-forming portions of the blank B to form the cutter-blank portions 5 and 6, in the forms shown in Figs. 7 and 11, without breaking the continuity of the peripheral line of the cutter-blank, a continuous strengthening-web (designated by 13 and shown most clearly in Figs. 8 and 10) is preserved, which extends entirely around the cutter-blank at a point approximately central between the side edges thereof, thereby maintaining the normal rigidity of the blank and better qualifying the same for sustaining the subsequent peripheral cutting operation, which would not be the case if the periphery of the blank was first kerfed or notched to form the teeth and the teeth formed thereby were subsequently bent in opposite directions, as with relatively thin cutters the cutter-teeth would be more or less resilient and would have a tendency to vibrate when resharpened or cut to bring the peripheral cutting-edges thereof into parallelism, which would, in a measure, reduce the precision of the cutting-edges of the teeth. This strengthening-web 13 lies intermediate to the two dotted lines 15 and 15′, (shown in Figs. 8 and 10,) or between opposite side faces of opposing tooth-blanks 5 and 6.

By reference to Fig. 11 of the drawings, which illustrates the swaged blank preparatory to having the tooth-blank portions thereof peripherally notched or cut away to form the teeth with intervening chip-spaces, as shown in Fig. 9, it will be seen that the tooth-blank portions 5 and 6, respectively, of the two sets of tooth-blank portions have their peripheries inclined in opposite directions relatively to each other and obliquely to the axis of the cutter-blank.

To form the teeth 12 with chip-spaces 10 intermediate thereto, and by the same operation to bring the apexes or extreme forward peripheral cutting-edges of the oppositely-disposed teeth into parallelism, as shown in Fig. 12, and thus produce the finished cutter, the periphery of each tooth-blank, as 5 or 6, will be notched or cut away by means of a cutting tool or mill, such as shown in dotted lines in Fig. 9, and at the same time a portion of the next adjacent preceding tooth-blank will be cut away slightly to true the peripheral cutting-edge of the succeeding tooth and bring the same into parallelism with the axis of the cutter, as will be readily understood by a comparison of Figs. 9, 11, and 12 of the drawings.

For the purpose of bringing the cutting-face of the cutter C to a predetermined width, and for the further purpose of providing a proper support or backing for the outer edges of the cutting-faces of the respective teeth, the side faces of the oppositely-disposed teeth 12 and 12′ will be ground, as at 14 and 14′, (see Fig. 13,) so as to bring the forward portion of the outer side face of each of the several teeth perpendicular to the cutting-edge of such tooth for a considerable distance to the rear of such cutting-edge, whereby a strong backing or support is provided for preventing chipping off, fracture, or distortion of the cutting-face. It will be obvious that this is a matter of considerable importance, as if a cutting-edge having an inwardly-retreating face were presented to the action of the work the teeth would be liable to be broken off or bent and the efficiency of the cutter impaired, if not destroyed.

Having thus described my invention, I claim—

1. The herein described cutter-blank for side-milling-cutters, it consisting of a discous blank having a continuous periphery, and having successive tooth-blanks inclined alternately crosswise of the blank in opposite directions respectively, and each tooth-blank having its two side faces merged into, or tangential with relation to the opposite side faces respectively, of the cutter-blank, substantially as described.

2. As an improved article of manufacture, a milling-cutter of the class described having a series of successive peripheral teeth of a uniform thickness, and of substantially the same thickness at their respective bases as the thickness of the cutter-body, and inclined transversely of said cutter-body alternately in opposite directions respectively, and having their peripheral faces equidistant from and in parallelism with the axis of the cutter, each tooth having the forward portion of its outer side face perpendicular to its peripheral cutting-face for a considerable distance to the rear of such cutting-face, whereby the cutting-faces of the teeth are firmly supported to prevent distortion, fracture, or chipping off of the same, adjacent to the outer ends of the

cutting-edges of the teeth, substantially as described.

3. The herein described milling-cutter blank for circular milling-cutters of the class specified, it consisting of a circular blank having a circuit of successive tooth-forming-blank portions, of a thickness coinciding substantially with the thickness of said blank, and extending outward, alternately, in opposite directions crosswise of said blank, and peripherally connected, midway of the thickness of said blank, by a continuous strengthening-web, and tooth-blank, each having one side face thereof projected beyond one or the other face of said blank, substantially as shown and described.

4. In an apparatus for forming milling-cutter blanks of the class specified, in combination, a relatively-fixed swaging-member having a circuit of alternating and corresponding tooth-blank-forming projections and tooth-blank-forming indentations upon and in, respectively, the working-face, and at or near, the periphery thereof, and having a plane-faced blank-holding and straightening middle portion between and within the circuit of, said projections and indentations; a relatively-movable swaging-member having a circuit of alternating and corresponding tooth-blank-forming indentations and tooth-blank-forming projections, complementary to, and adapted to coact with, the tooth-blank-forming projections and tooth-blank-forming indentations, respectively, of the relatively-fixed member, and also having a plane-faced blank-holding and straightening middle portion between and within the circuit of said projections and indentations, and adapted for coacting with the similar plane-faced portion of the relatively-fixed member for holding and straightening a blank, during the operation of swaging said blank between said two members; and both members being adapted for coaction to form successive circumferentially-disposed tooth-blanks in an untoothed cutter-blank, which are alternately inclined in opposite directions, respectively and crosswise of the cutter-blank; and means in connection with said swaging-members, and adapted for holding the cutter-blank against transverse movement, relatively to said members, substantially as described, and for the purpose set forth.

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