(No Model.) 3 Sheets—Sheet 1.

G. F. SIMONDS.

DEVICE FOR KNURLING THE SURFACES OF METAL ARTICLES.

No. 446,933. Patented Feb. 24, 1891.

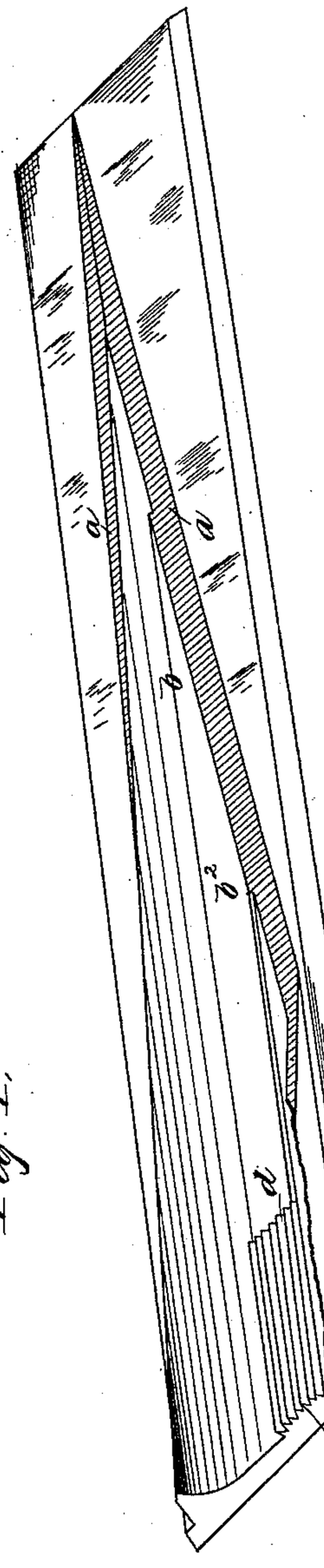

Fig. 1.

Fig. 3.

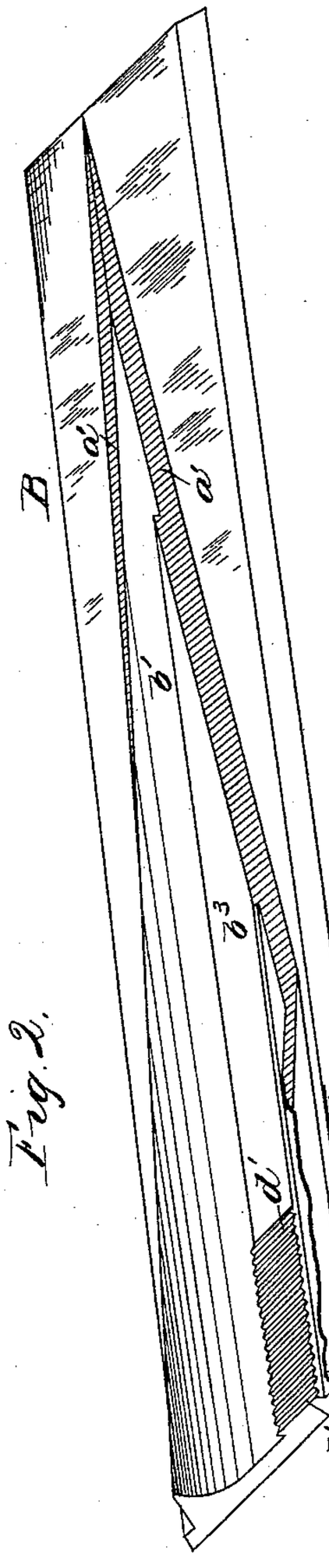

Fig. 2.

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(No Model.) 3 Sheets—Sheet 2.

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DEVICE FOR KNURLING THE SURFACES OF METAL ARTICLES.

No. 446,933. Patented Feb. 24, 1891.

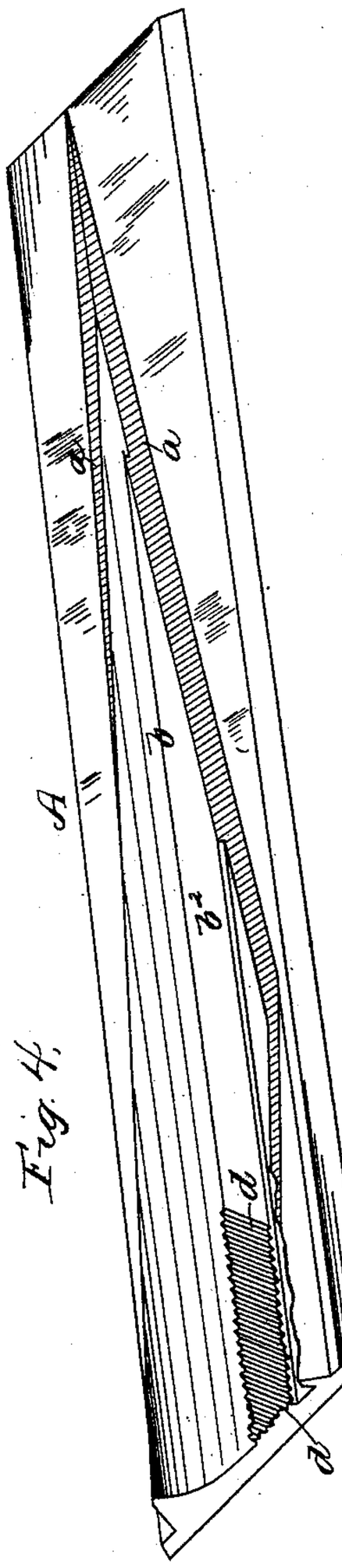

Fig. 4.

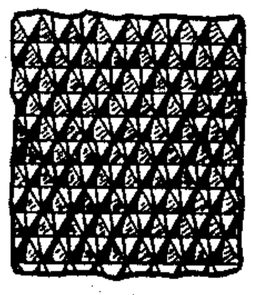

Fig. 6.

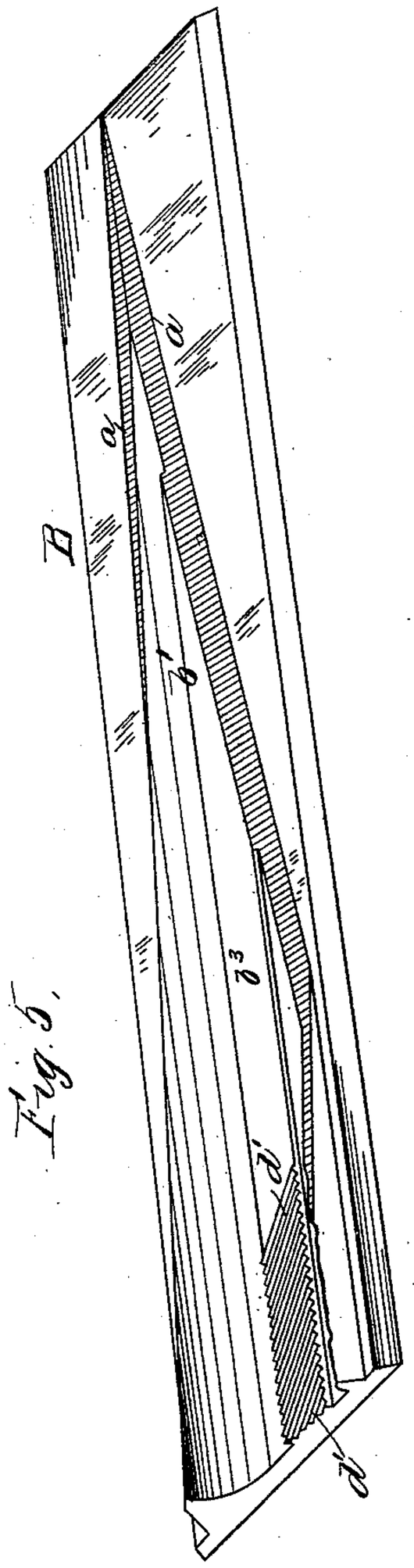

Fig. 5.

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(No Model.) 3 Sheets—Sheet 3.

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DEVICE FOR KNURLING THE SURFACES OF METAL ARTICLES.

No. 446,933. Patented Feb. 24, 1891.

Fig. 7.

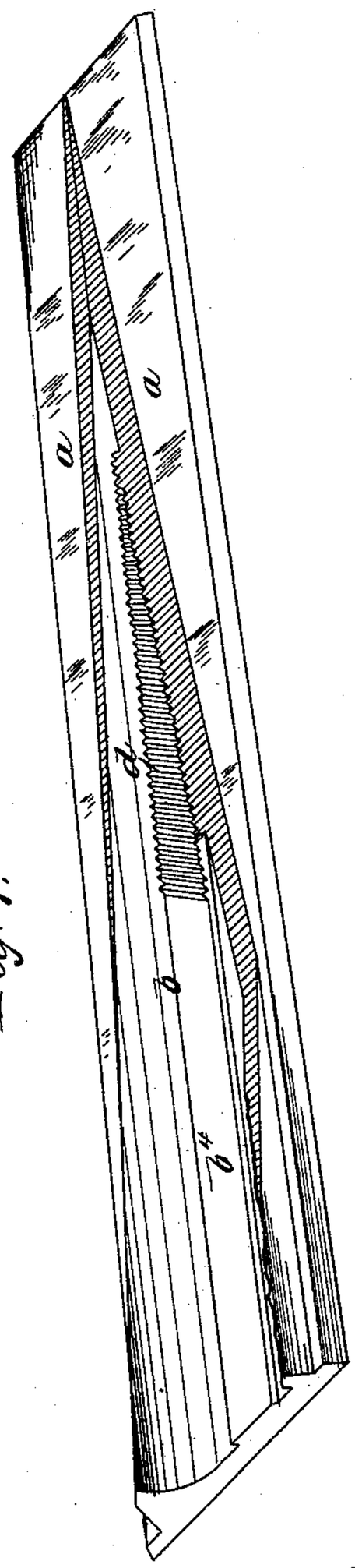


Fig. 9.

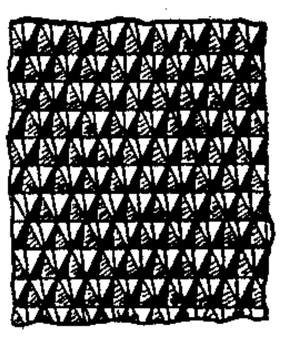


Fig. 8.

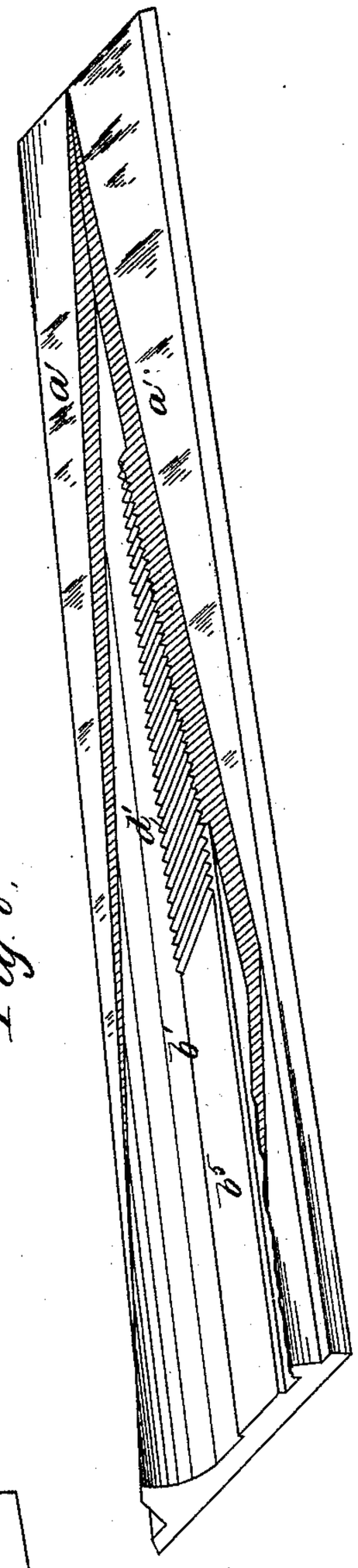
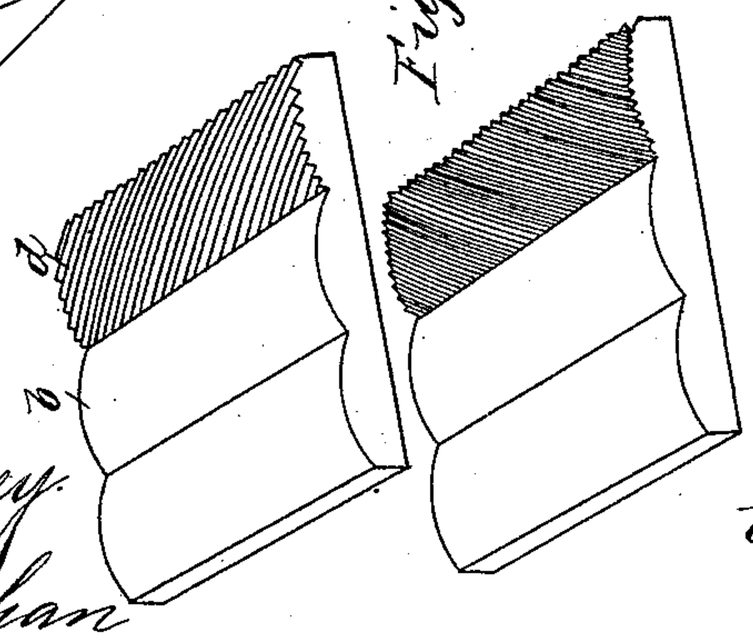


Fig. 10.



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UNITED STATES PATENT OFFICE.

GEORGE F. SIMONDS, OF FITCHBURG, MASSACHUSETTS.

DEVICE FOR KNURLING THE SURFACES OF METAL ARTICLES.

SPECIFICATION forming part of Letters Patent No. 446,933, dated February 24, 1891.

Application filed August 25, 1890. Serial No. 362,975. (No model.)

To all whom it may concern:

Be it known that I, GEORGE F. SIMONDS, of Fitchburg, county of Worcester, State of Massachusetts, have invented an Improvement in Methods of and Apparatus for Knurling or Corrugating the Surfaces of Metal Articles, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

My invention relates to a method of knurling or corrugating the surfaces of metal bars and to dies for producing knurled surfaces on such bars.

In Patent No. 319,754, dated June 9, 1885, I have shown and described dies for forging metal articles that are circular in cross-section and of any desired shape in longitudinal section, and in applications, Serial No. 362,596, filed August 21, 1890, and Serial No. 362,967, filed August 25, 1890, I have shown and described means for rolling forgings that are non-circular in cross-section. The present invention is applicable to dies such as shown in said patent, but may be made and used independently of such dies.

The apparatus forming the subject of this invention comprises a pair of dies adapted to move in opposite directions with relation to the blank or billet that is being operated upon, and which rotates between said dies. One of said dies is provided with a series of projections or ridges, which indent or produce a corresponding series of depressions or grooves in the surface of the blank or billet, and the other of said dies is provided with a series of ridges or projections, which also produce a series of depressions or grooves on the same part of the surface of the blank, and the ridges of the two dies are so arranged that the corresponding grooves produced by them on the forging intersect one another, and thus form a number of separate projections on the surface of the forging. The direction, size, and shape of the ridges on the dies may be made according to the character of the surface to be produced, and the construction and arrangement of the knurling-dies may be varied in numerous ways.

Figures 1 and 2 are perspective views of a pair of dies having a portion that produces a knurled surface on a portion of the forging made by the dies; Fig. 3, an enlarged view of a portion of the knurled surface produced by the dies shown in Figs. 1 and 2; Figs. 4 and 5, perspective views of a similar pair of dies having the ridges that produce the knurling at an acute angle with one another instead of at right angles, as in Figs. 1 and 2; Fig. 6, an enlarged view of a portion of the knurled surface produced by the dies represented in Figs. 4 and 5, the projections of said surface being diamond-shaped instead of square, as in Fig. 3; Figs. 7 and 8, perspective views of a pair of dies for produced a knurled surface similar to that produced by the dies represented in Figs. 4 and 5, but the said knurling-dies having a different construction and different arrangement with relation to the other parts of the composite dies of which they form a part; Fig. 9, an enlarged view of a portion of the surface produced by the dies represented in Figs. 7 and 8, and Fig. 10 a perspective view of dies for knurling the surface of a hexagonal bar.

The dies forming the subject of this invention for producing knurled surfaces are shown in the drawings as parts of dies A B, which also embody the invention described in Letters Patent No. 319,754. The said dies are adapted to be used in a machine substantially like that represented in Patent No. 319,752, dated June 9, 1885, by which they are moved in opposite directions with relation to the round blank or billet which is placed between them and rotated by them while having the desired shape imparted to it. The said dies have spreading and reducing surfaces $a\ a'$, which diverge with relation to the path of movement of the dies and are inclined to the surface of the bed portion of the dies, as described in said Patent No. 319,754.

Between the spreading and reducing portions $a\ a'$ are the raised forming-surfaces $b\ b'$, which, in connection with the spreading and reducing surfaces $a\ a'$, give the forging the desired shape in longitudinal section, which is that of a conical projectile.

The working-faces of the dies, as represented in Figs. 1, 2, 4, and 5, have forming projections $b^2\ b^3$, which produce a groove or depression in the projectile near its base, and this groove is the part that is to have its surface corrugated or knurled. This corrugation

or knurling is produced by ridges $d\,d'$, which, as shown in Figs. 1, 2, 4, and 5, are raised from the forming-surfaces $b^2\,b^3$, that have shaped the portion of the forging that is to have its surface knurled, and this action is subsequent to and independent of the action of the shaping or forming part of the dies. The set of ridges d on one die are parallel with one another; but the two sets $d\,d'$ are at different angles to the path of movement of the dies, and as the dies move over the blank each set of ridges produces a series of grooves on the forging and one set of grooves intersects the other on the surface of the metal, the two sets thus producing a number of uniform projections, as represented in Figs. 3, 6, and 9.

The ridges $d\,d'$ may be of any desired shape and set at any desired angle to the path of movement of the dies, and one set of ridges may be finer or of different shape from the other set, thus varying the character of the surface produced, according to the purpose for which the article is intended. For example, in the form shown in Figs. 1 and 2 one set of ridges is parallel with the path of movement of the dies and produces a set of circumferential grooves around the forging, and the other set is at right angles to the path of movement of the dies and produces a series of longitudinal grooves in the forging.

The article to be knurled by this method is acted upon at diametrically-opposite sides and indented or grooved while being rotated, so that the indentations or grooves produced simultaneously at opposite sides are carried progressively around the surface as the blank rotates, and one set of grooves is shown as made at a different angle in the surface from the other set, so that the said grooves intersect one another.

In the dies shown in Figs. 7 and 8 the construction of the knurling portion and its arrangement with relation to the forming portion of the dies is somewhat different from that represented in Figs. 1, 2, 4, and 5. In Figs. 7 and 8 the rigid or knurling portions $d\,d'$ intersect with and co-operate with the spreading and reducing surfaces $a\,a'$, so that the surface of the forging is knurled progressively at the same time that this portion of the forging is brought to the desired shape. In the dies shown the knurling-surfaces $d\,d'$ are formed on a high part of the forming-surface of the die, and consequently the surface of the forging is depressed with relation to the part of the forging produced by the forming-surface $b\,b'$ of the dies at the same time that it is knurled. Instead of being impressed into the entire length of the knurled portion at once, as is effected by the dies represented in Figs. 1, 2, 4, and 5, they are impressed first in a short portion of the said surface, and then gradually lengthened, as the said surface is brought by the spreading-surfaces $a\,a'$ of the die to the desired diameter.

The surfaces $b^4\,b^5$ of the dies (represented in Figs. 7 and 8) that meet the forging after the knurling-surfaces $d\,d'$ have acted upon them are of such height as not to press upon the projections or knurling of the forging, but merely engage with the same sufficiently to assist in guiding the forgings, as they are subsequently acted upon by the other parts of the die.

In Fig. 10 the ridges that produce the knurling are on the raised forming-surface of the dies, such as shown in applications, Serial No. 362,596, filed August 21, 1890, and Serial No. 362,967, filed August 25, 1890, by which the surface of an article rolled to a polygonal sectional shape is knurled.

Knurling-dies or rigid portions such as represented at $d\,d'$ may be employed as parts of composite dies having other parts that perform various other operations in the production of rolled forgings, as shown and described in various other patents and applications for patents made by me, the special form of die herein shown being chosen merely for the purpose of illustration; and in said composite dies the knurling portion may be arranged to operate before or after or simultaneously with the other parts of the die, as may be found the most convenient.

I claim—

1. A pair of dies for knurling the surfaces of metal articles, each of which has a series of ridges lying in a different direction with relation to the path of movement of the dies from the ridges of the opposite die, as set forth, whereby the ridges of each die make a separate series of grooves in the same portion of the surface of the article which intersect one another, substantially as and for the purpose described.

2. Dies for forming metal forgings and corrugating portions of the surface thereof, the said dies having raised working portions that have inclined spreading and reducing surfaces and a forming-surface between them, said forming-surfaces being provided with ridges for corrugating or grooving the surface of the article, substantially as described.

3. The herein-described method of knurling the surfaces of metal articles by rolling them between dies which indent the said surfaces simultaneously at opposite places and produce intersecting grooves progressively around the surfaces.

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

GEO. F. SIMONDS.

Witnesses:

JOS. P. LIVERMORE,

JAS. J. MALONEY.