(No Model.) 5 Sheets—Sheet 1.

G. F. SIMONDS.

MAKING ROLLED FORGINGS NON-CIRCULAR IN CROSS SECTION.

No. 446,934. Patented Feb. 24, 1891.

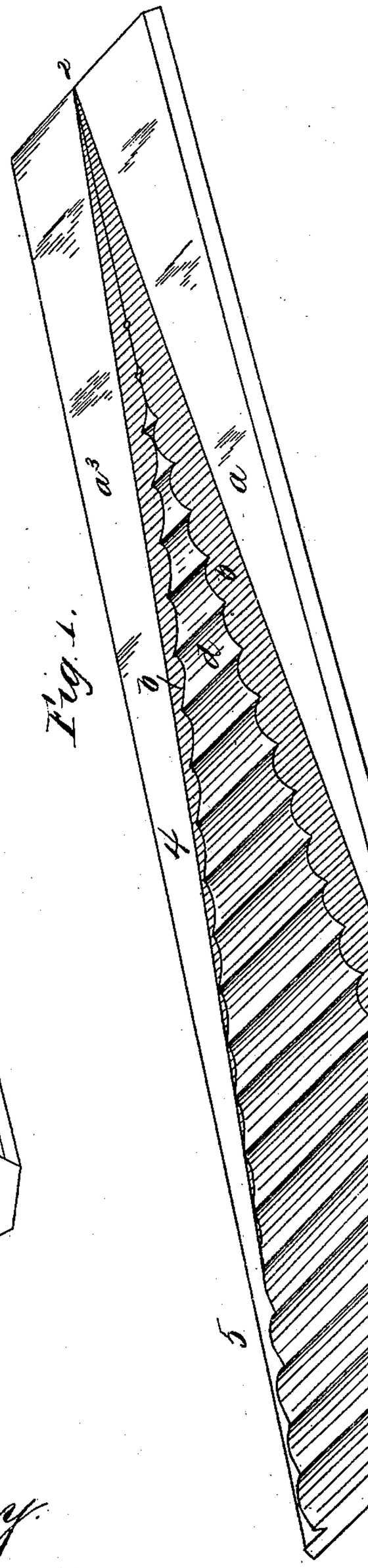

Fig. 1.

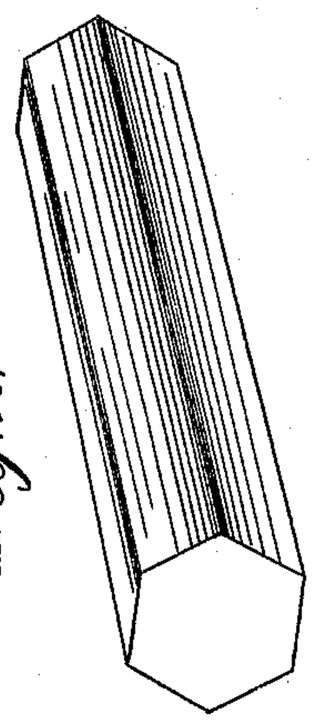

Fig. 2.

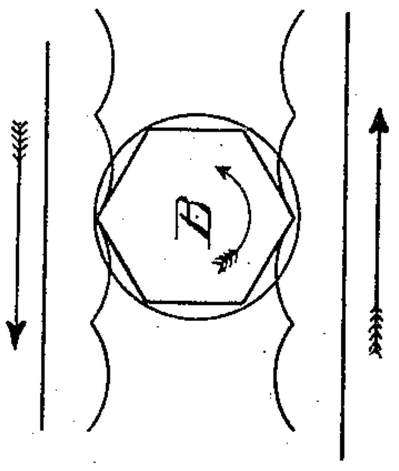

Fig. 3.

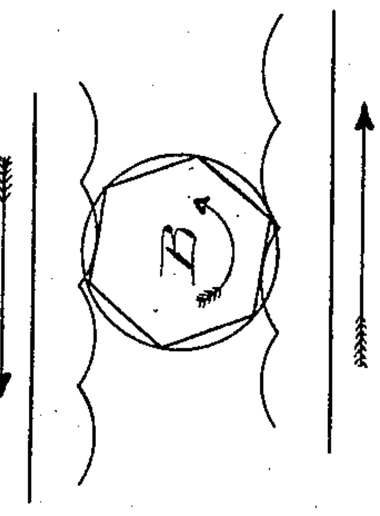

Fig. 4.

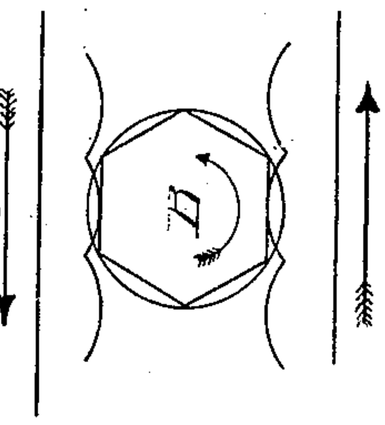

Fig. 5.

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G. F. SIMONDS.

MAKING ROLLED FORGINGS NON-CIRCULAR IN CROSS SECTION.

No. 446,934. Patented Feb. 24, 1891.

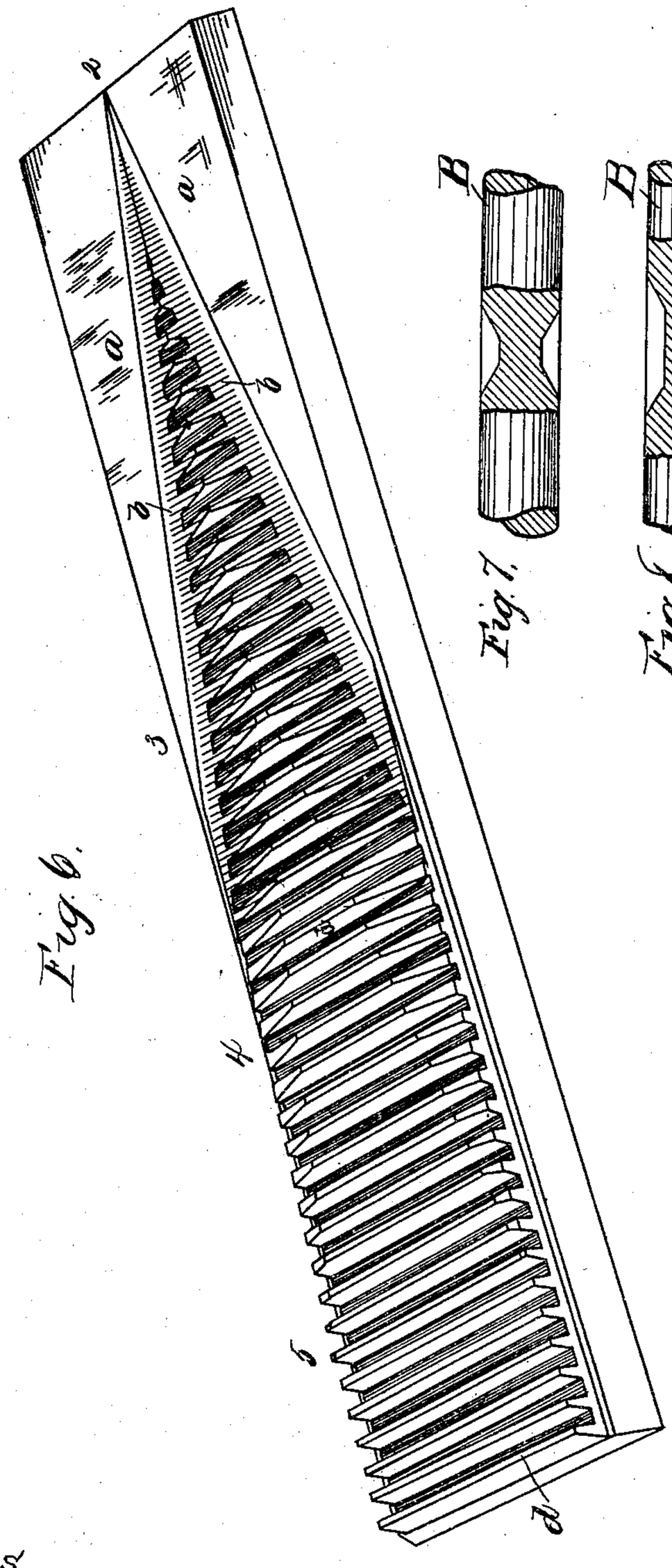

Fig. 6.

Fig. 7.

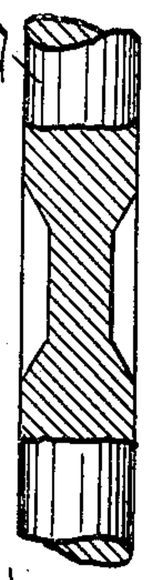

Fig. 8.

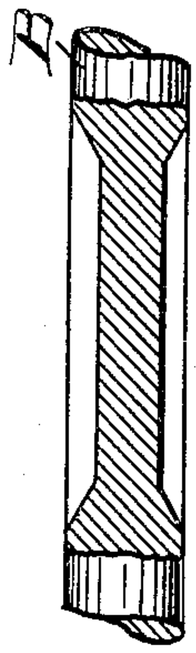

Fig. 9.

Witnesses.
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MAKING ROLLED FORGINGS NON-CIRCULAR IN CROSS SECTION.

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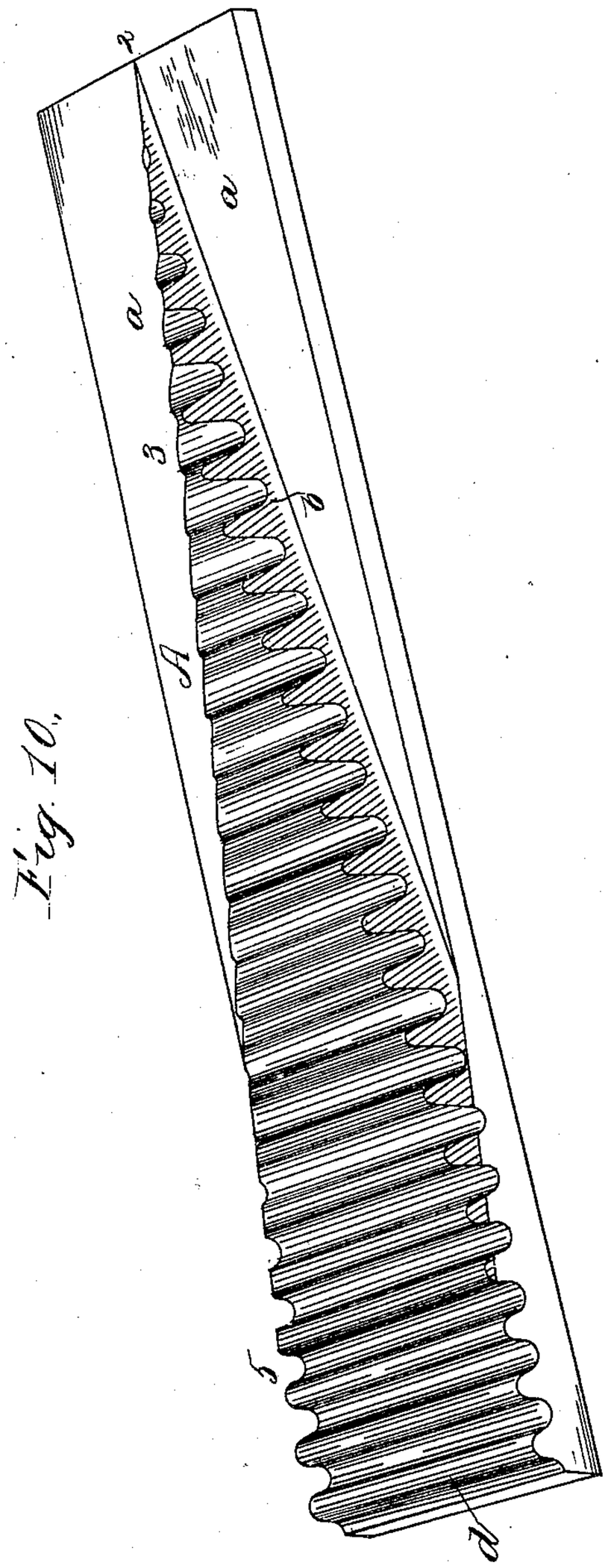

Fig. 1.

Witnesses.
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MAKING ROLLED FORGINGS NON-CIRCULAR IN CROSS SECTION.

No. 446,934. Patented Feb. 24, 1891.

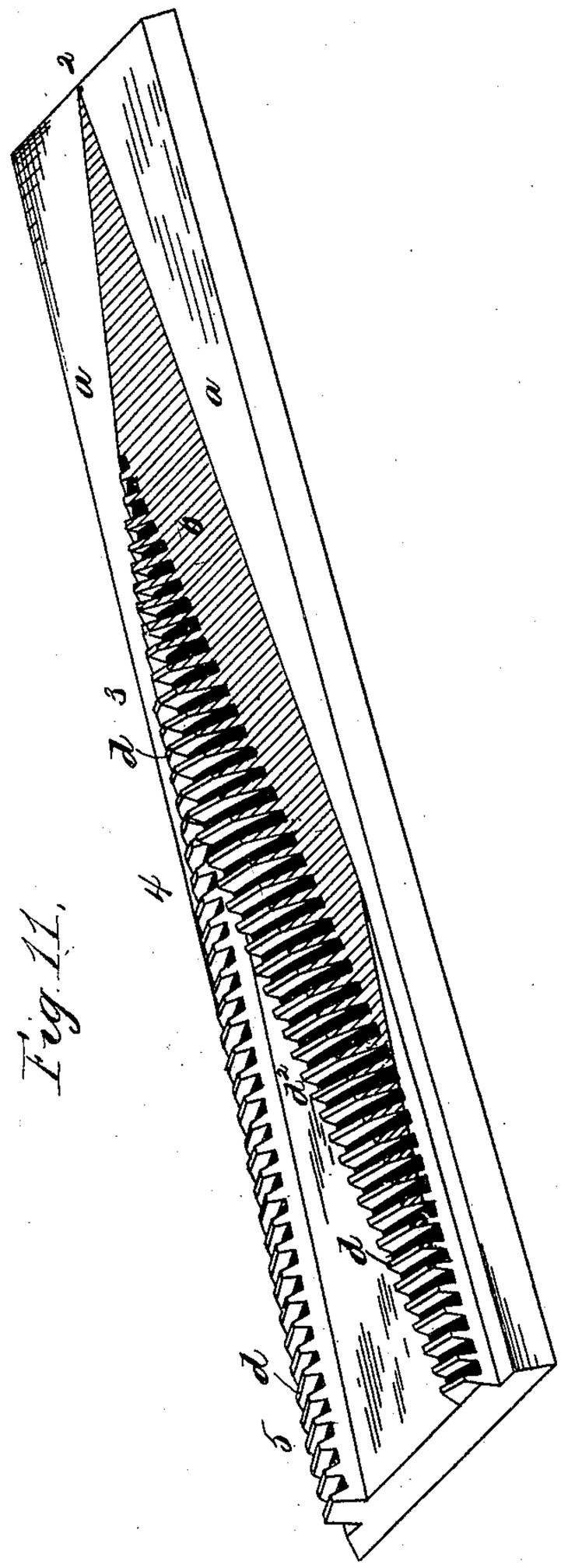

Fig. 11.

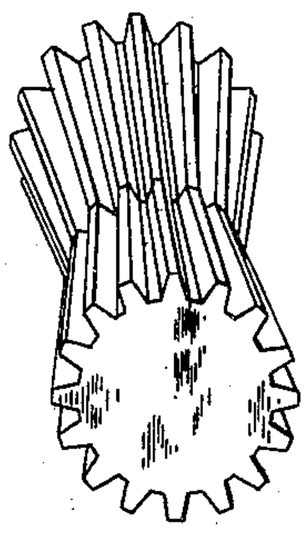

Fig. 11a.

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(No Model.) 5 Sheets—Sheet 5.

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MAKING ROLLED FORGINGS NON-CIRCULAR IN CROSS SECTION.

No. 446,934. Patented Feb. 24, 1891.

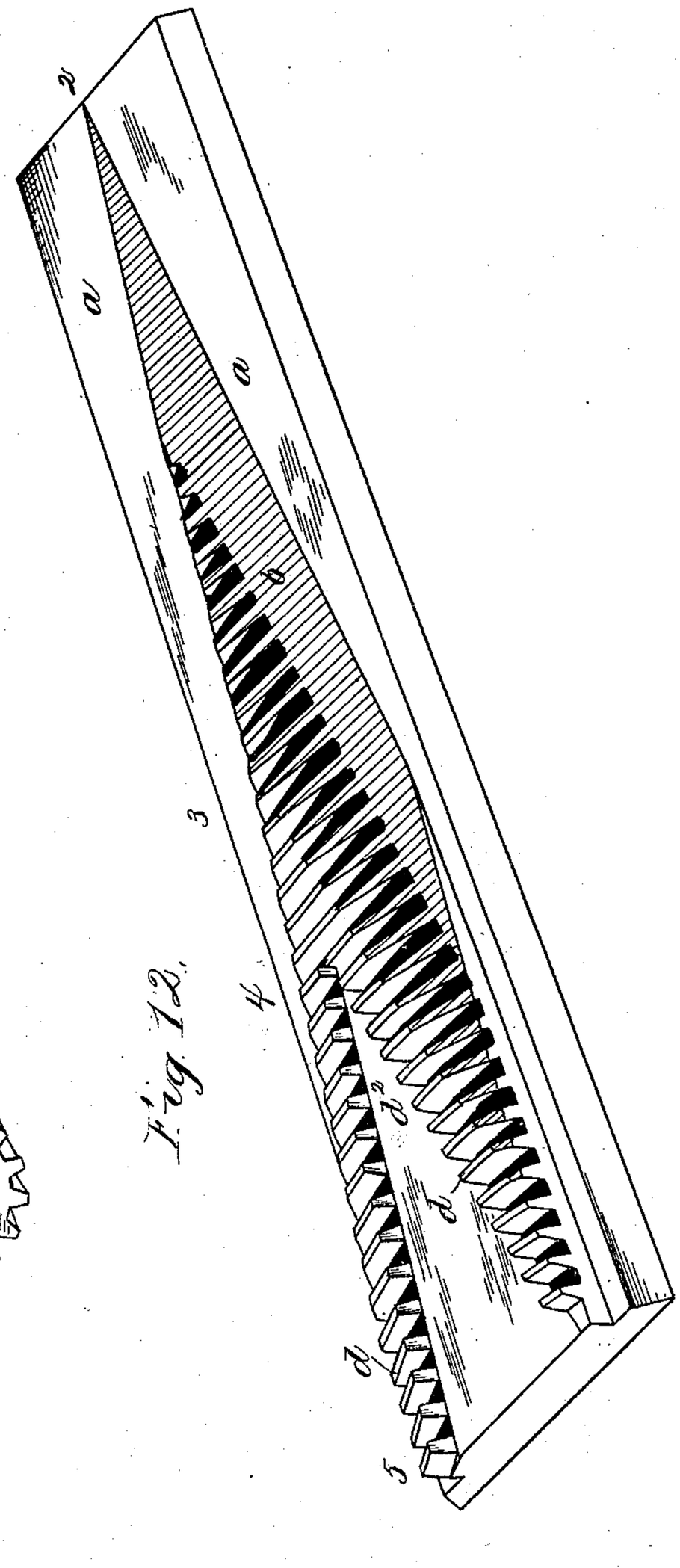

Fig. 12.

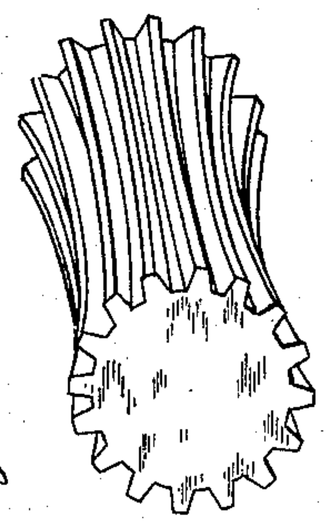

Fig. 12ª.

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Lillian E. Preston

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UNITED STATES PATENT OFFICE.

GEORGE F. SIMONDS, OF FITCHBURG, MASSACHUSETTS.

MAKING ROLLED FORGINGS NON-CIRCULAR IN CROSS-SECTION.

SPECIFICATION forming part of Letters Patent No. 446,934, dated February 24, 1891.

Application filed August 25, 1890. Serial No. 362,976. (No model.)

To all whom it may concern:

Be it known that I, GEORGE F. SIMONDS, of Fitchburg, county of Worcester, and State of Massachusetts, have invented an Improvement in Methods of and Apparatus for Making Rolled Forgings Non-Circular in Cross-Section, of which the following description, in connection with the accompanying drawings, is a specification, like letters and figures on the drawings representing like parts.

My invention relates to a method of and apparatus for forging articles that are polygonal, fluted, serrated, or of other desired non-circular shape in cross-section by rolling the bar to be forged between dies which move in opposite directions.

In Patent No. 319,754, dated June 9, 1885, I have shown and described dies for forging metal articles circular in cross-section, said dies being moved in opposite directions over the metal to be shaped, which rolls or rotates on an axis between them. The said dies have reducing and spreading surfaces by which the metal is spread or crowded axially along the blank that is being rolled, thus bringing the said blank to the desired shape in longitudinal section.

The object of the present invention is to forge, by rolling, an object that is not circular in cross-section. This method and apparatus may be used, for example, for producing gears or fluted surfaces or polygonal surfaces; or, in fact, various shapes may be suggested in which the surface, although non-circular, is usually substantially symmetrical to the axis of rotation of the object in the process of forging. The dies for producing such objects in accordance with this invention have raised forming-surfaces and reducing and spreading surfaces running diagonally to the line of movement of the die, and standing obliquely to the plane of the die and above or between the said spreading and reducing surfaces the forming-surface of the die is made with raised portions and depressions, which correspond to or, as it may be called, "mesh" with the elevations and depressions of the surface of the object being rolled. If, for example, the object to be forged is a gear, the forming-surface of the die will be substantially that of a rack, which would mesh with said gear. If the surface of the article is to be a polygon, the forming-surface of the die is waved or scalloped. The relation of the reducing and spreading surfaces to the forming-surface of the die is such that the metal blank is acted upon first at one point on its length and is rolled to the desired cross-sectional shape for a short portion of its length, and then as it continues to rotate between the dies the surplus metal is crowded axially along the blank, lengthening the portion that is brought to the proper shape until finally the desired shape is imparted to the entire length that is to be shaped.

Figure 1 is a perspective view of a die for forging polygonal objects in accordance with this invention; Fig. 2, a perspective view of a portion of a bar shaped by a pair of dies such as represented in Fig. 1; Figs. 3, 4, and 5, diagrams representing the shape of the pair of dies in longitudinal section and different positions of the blank or object being rolled with relation to the surface of the said dies; Fig. 6, a perspective view showing a die of proper shape to forge a gear from a round bar in accordance with this invention; Figs. 7, 8, and 9, diagram views representing the shapes of the blank in cross-section at different periods in the process of rolling and the manner in which the shape is imparted to the forging at one point on its length after another. Fig. 10 is a perspective view of a die for forging fluted articles; and Figs. 11 and 12, perspective views of dies for forging articles toothed in cross-section and of different cross-sectional area at different portions of the length thereof, dies such as shown in Fig. 11 making a pair of bevel-pinions, apex to apex, Fig. 11ª, and dies such as shown in Fig. 12 making a worm-gear, Fig. 12ª.

The base or body *a* of the die may have a plane surface, and the co-operating pair of dies are arranged one over the other, as indicated in Figs. 3, 4, and 5, with the bed portions *a* separated from one another by a distance about equal to the diameter of the bar or blank to be rolled. From the surface of the bed *a* are raised the spreading and reducing surfaces *b*, which incline upward from the surface *a* and converge toward one another in the direction in which the dies move, so that they meet at the point 2, where the dies begin to act on the cylindrical bar or blank B in

the space between them, substantially in the manner described in my patent hereinbefore referred to. The said reducing and spreading surfaces *b* are provided with teeth or corrugations to engage with the bar and insure its rotation. The said surfaces *b* when they begin to act on the bar reduce its diameter and at the same time spread the metal, moving it away from the point where the dies begin to act toward the ends of the bar.

The upper or forming surface *d* of the die between the spreading and reducing surfaces *b* is, in accordance with the present invention, shaped in longitudinal section throughout the entire length of the working part of the die in accordance with the cross-sectional shape desired to be imparted to the forging. By this construction when the blank or billet being rolled is about opposite the point 3 on the die it will have a short portion of its length brought to the desired shape in cross-section, and then as the die progresses until the parts opposite the points 4 and 5 arrive at and operate upon the blank the said portion that is of the proper shape is gradually lengthened, as shown in Figs. 7, 8, and 9, the surplus metal that has to be displaced to bring the cylindrical blank to the desired shape having been crowded axially along the bar, so that in the operation of the dies the shape is gradually imparted to the bar lengthwise thereof. By properly shaping the upper or forming surface *d* of the dies various cross-sectional shapes may be imparted to the bar by this method of first reducing a short length of the bar to the desired shape by indenting it or forming depressions around it, and then gradually extending the said depressions lengthwise of the bar by crowding the surplus metal along in the direction of the axis of rotation of the bar. By properly proportioning the length and curvature of the waves of the surface *d* to the distance between the dies (shown in Figs. 1, 3, 4, and 5) the bar may be rolled to various polygonal shapes—for example, square or hexagonal, the forms that are most generally used for bolt-heads and similar purposes, and by the shape shown in Fig. 6 a toothed wheel or pinion may be forged from a cylindrical piece, and by the shape shown in Fig. 10 a bar with a fluted surface may be forged. These several shapes show that the method and apparatus are not limited to the production of any specific cross-sectional shape of the forging.

The shapes produced by the dies shown in Figs. 1, 6, and 10 are uniform in cross-section throughout their length; but other shapes can be produced. For example, the dies shown in Figs. 11 and 12 produce toothed forgings varying in cross-section in different parts of their length. In such dies the forming-surface is cut away at the middle, leaving only a narrow portion adjacent to the spreading and reducing surfaces, so as to not interfere with the proper rotation of the article by the portion of the reducing and forming surfaces at each moment acting upon it. Dies of this kind may be used as parts of composite dies made in accordance with Patent No. 319,754, before referred to, and embodying others of my inventions relating to the manufacture of rolled forgings. Such composite dies may be made in part to roll an article having portions that are circular in cross-section, and of any desired shape in longitudinal section in connection with fluted, toothed, or polygonal portions—as, for example, a bolt-blank having a polygonal portion or head produced by dies having a portion like that represented in Fig. 1 and a cylindrical shank of smaller diameter produced by rolling down the adjacent portion of the metal by dies such as shown in Patent No. 319,754; or a gear or pinion may be rolled in one piece with a reduced portion that may serve as an arbor, by the use of composite dies, one portion of which is like the die represented in Fig. 6.

I claim—

1. Dies for forming forgings non-circular in cross-section, the said dies having raised working portions that have inclined spreading and reducing surfaces and a forming-surface between them having elevations and depressions, substantially as described.

2. That improvement in the art of making non-cylindrical forgings from cylindrical blanks which consists in indenting or depressing portions of the blank about its periphery and gradually crowding or spreading the metal thus displaced lengthwise of the blank until the desired cross-sectional shape is imparted to any desired length of the blank, substantially as described.

3. The method herein described of making rolled metal forgings non-circular in cross-section by acting upon a bar so as to cause it to rotate and at each rotation to indent portions of the bar around its periphery, crowding and spreading the metal axially, and compressing it to the desired shape, substantially as described.

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.