No. 671,450. Patented Apr. 9, 1901.

C. PROUTY.

APPARATUS FOR ROLLING TAPERING METAL FOR SAWS OR THE LIKE.

(Application filed Mar. 3, 1896.)

(No Model.) 5 Sheets—Sheet 1.

Fig. 1.

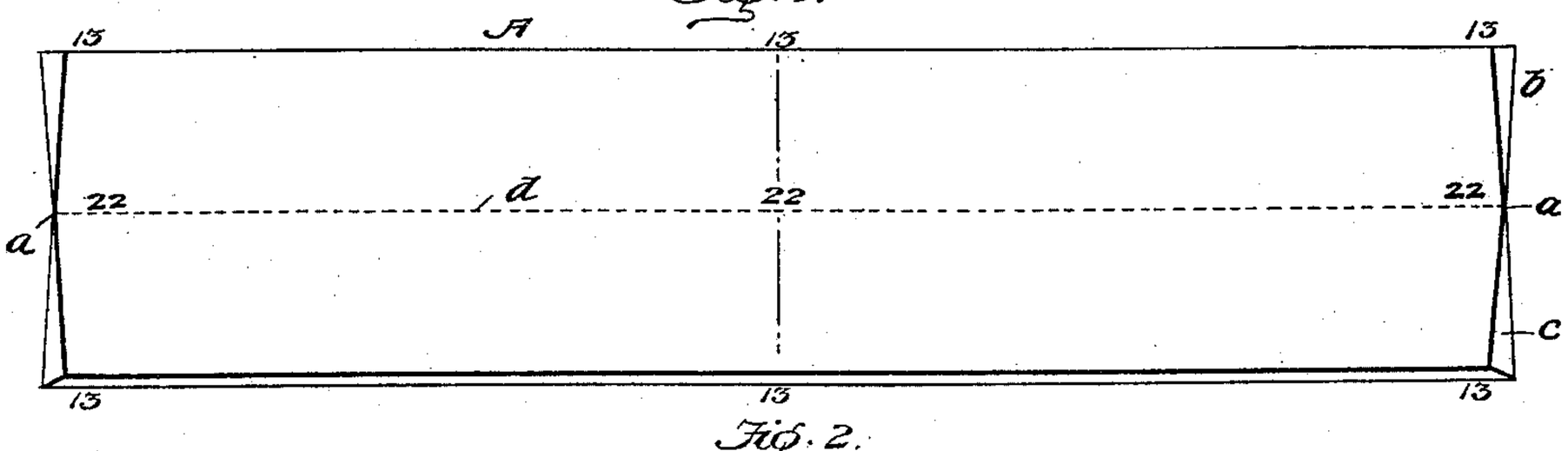


Fig. 2.

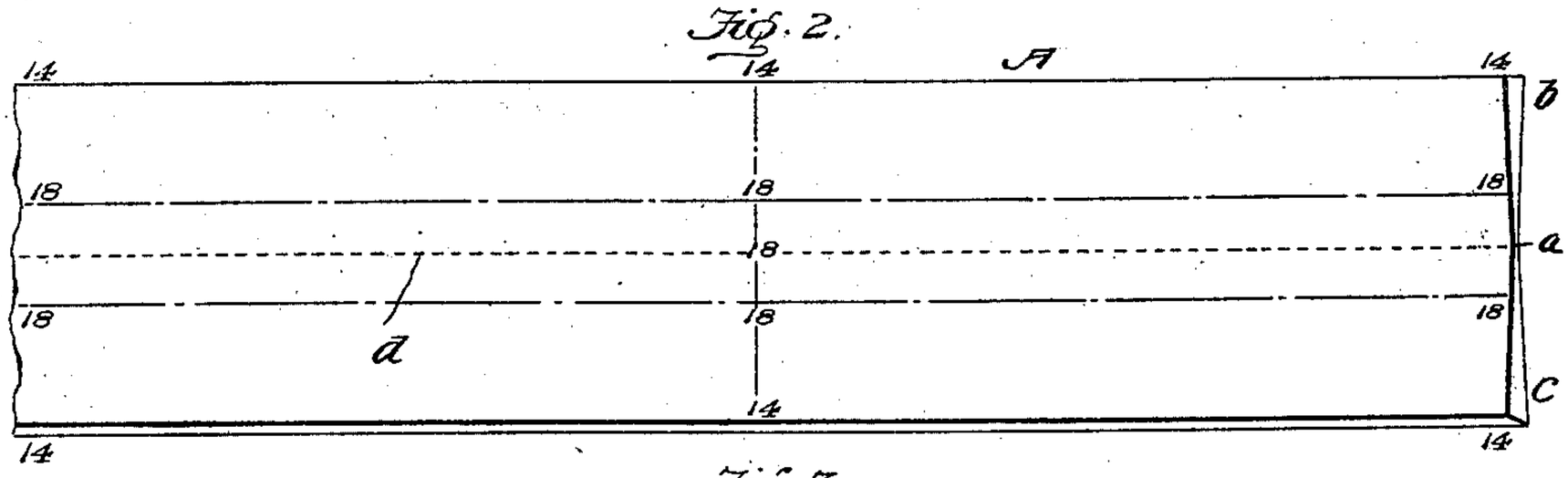


Fig. 3.

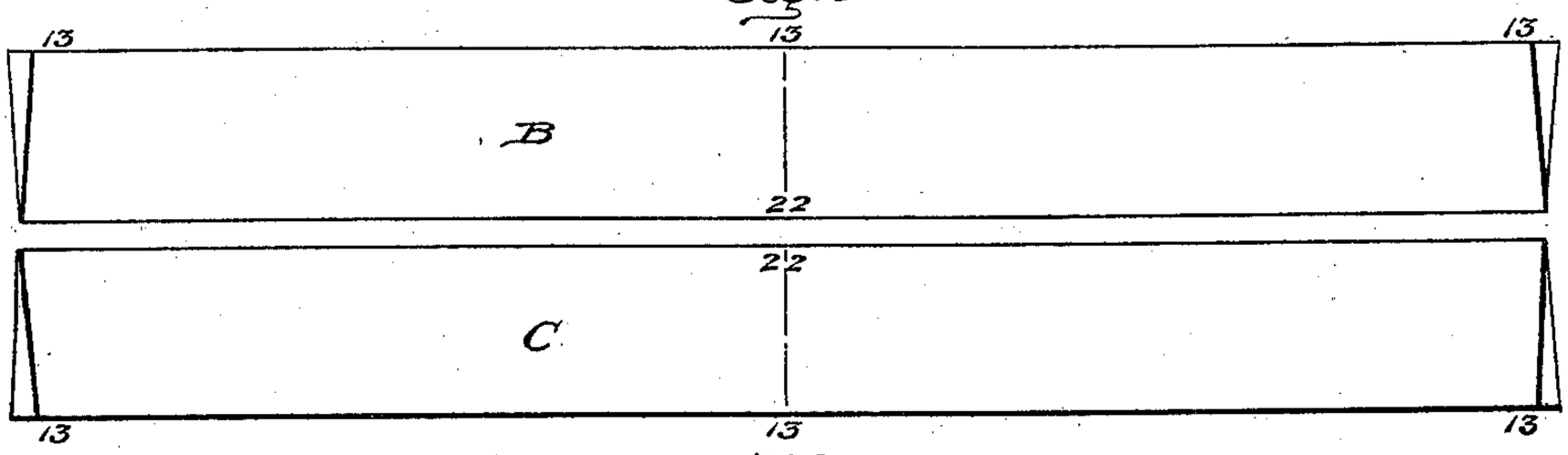


Fig. 4.

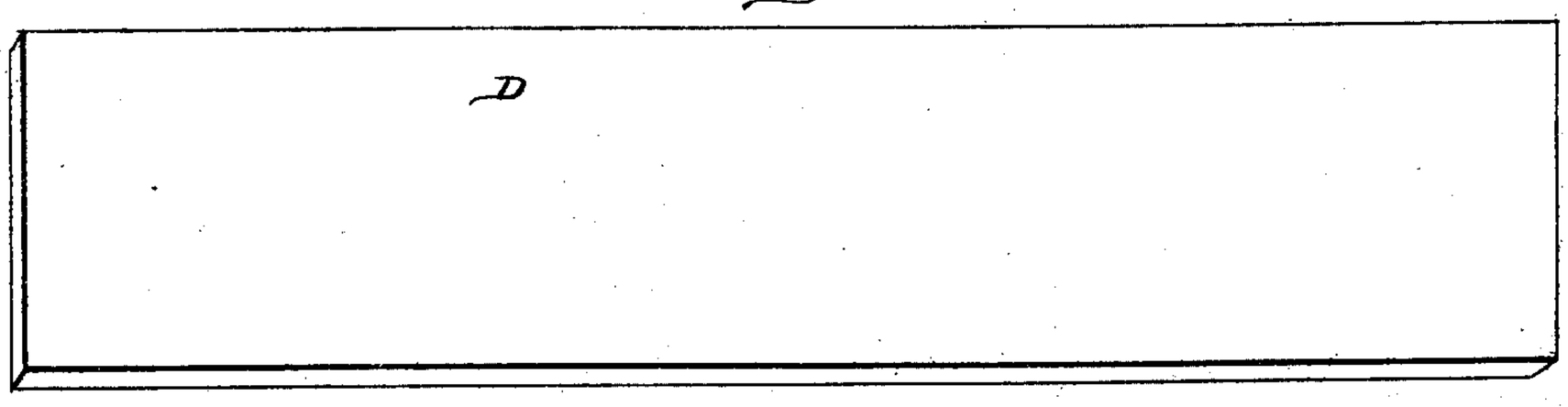
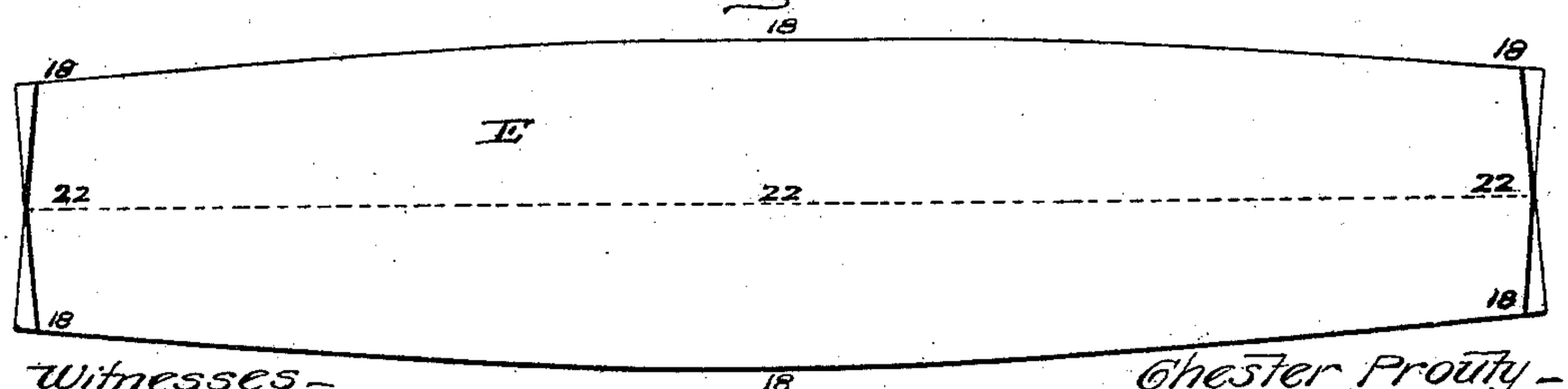


Fig. 5.



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(No Model.) 5 Sheets—Sheet 2.

Fig. 6.

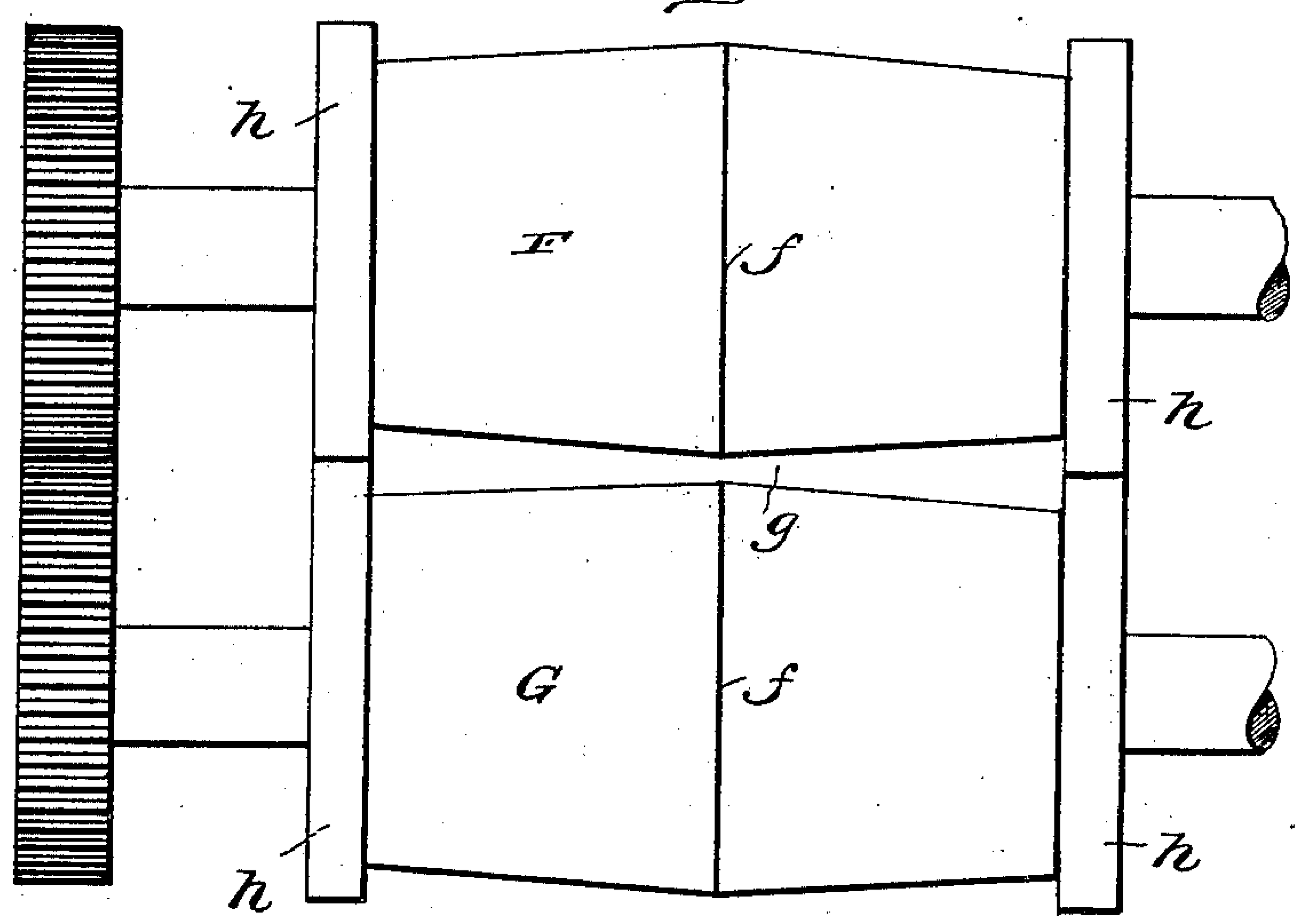
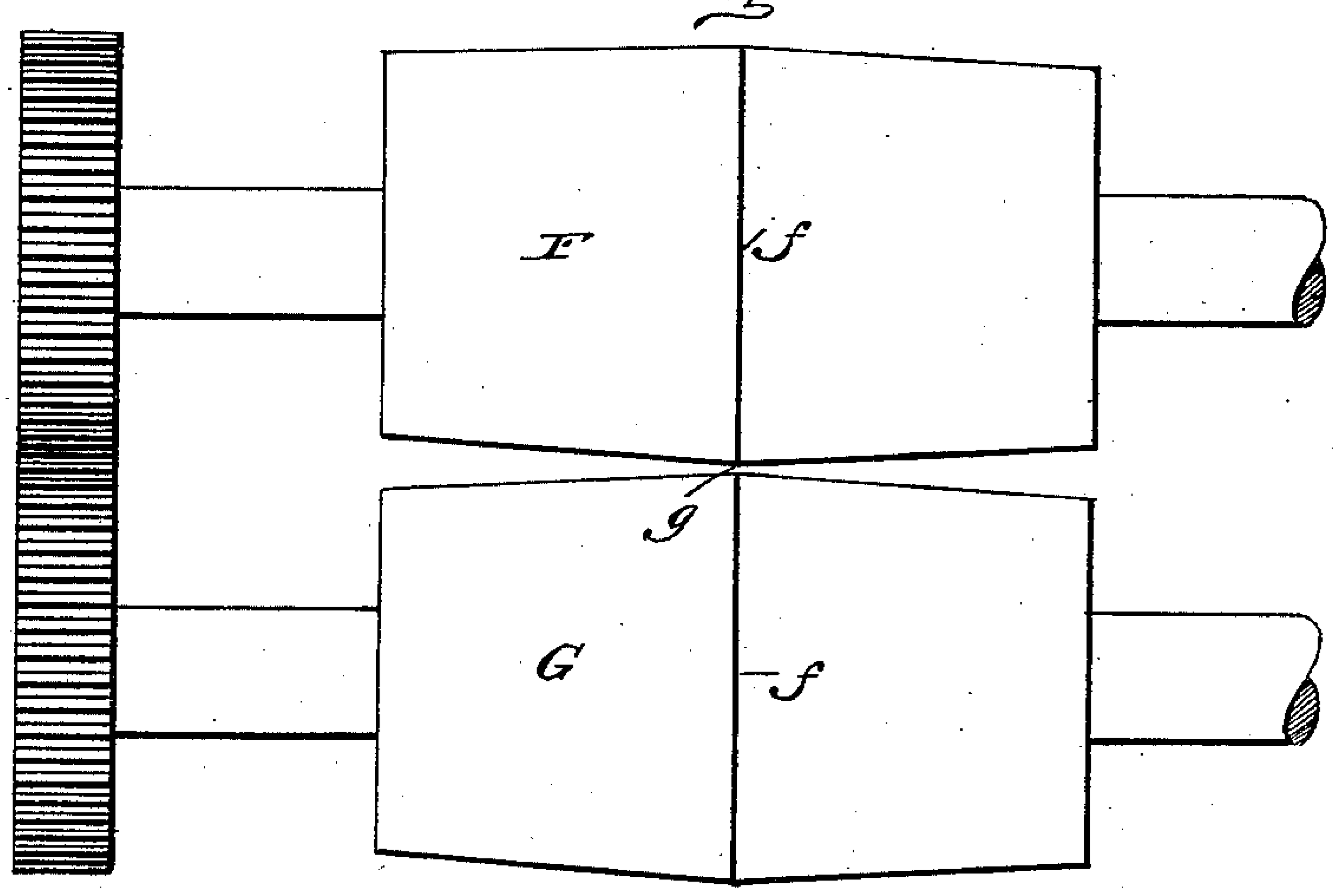


Fig. 7.



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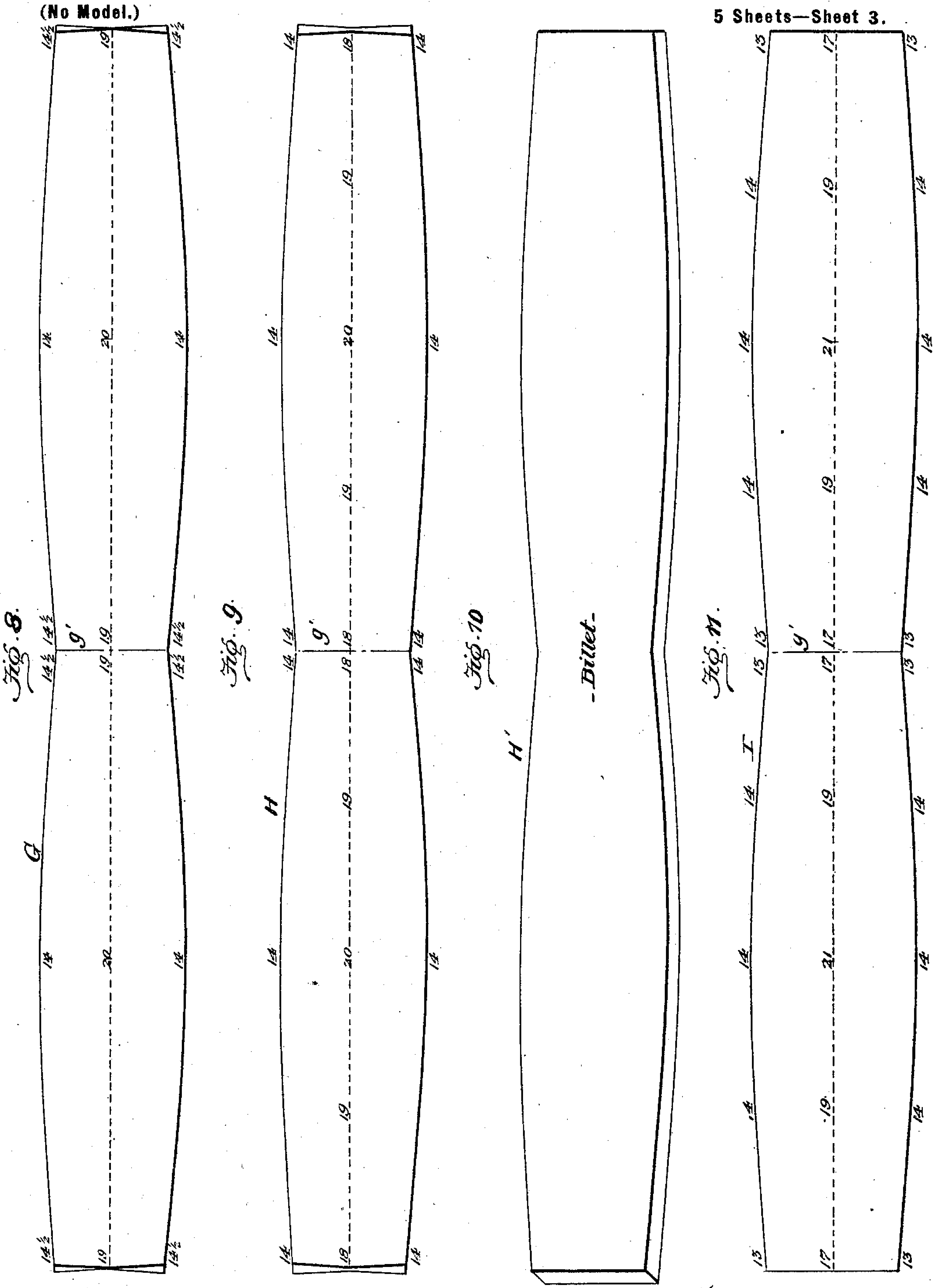
(No Model.) 5 Sheets—Sheet 3.



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(No Model.) 5 Sheets—Sheet 4.

Fig. 12.

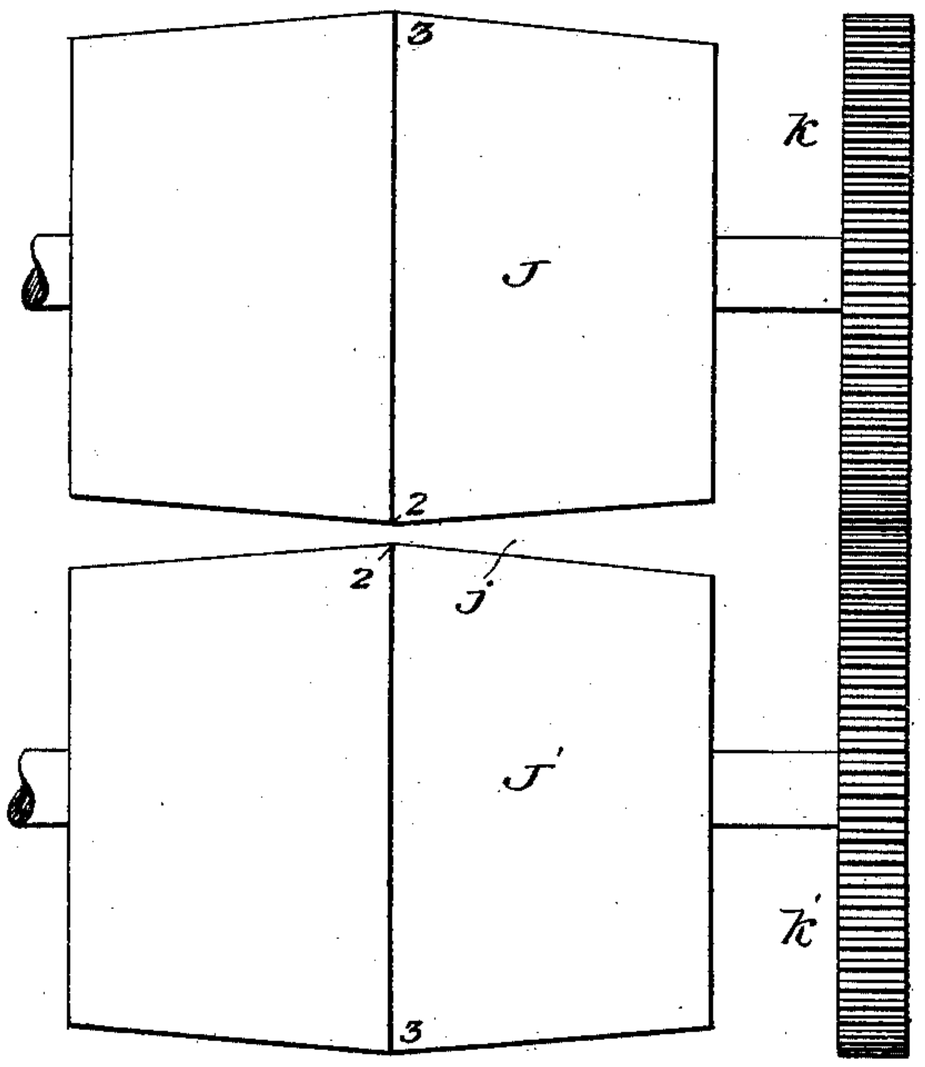


Fig. 13.

Fig. 14

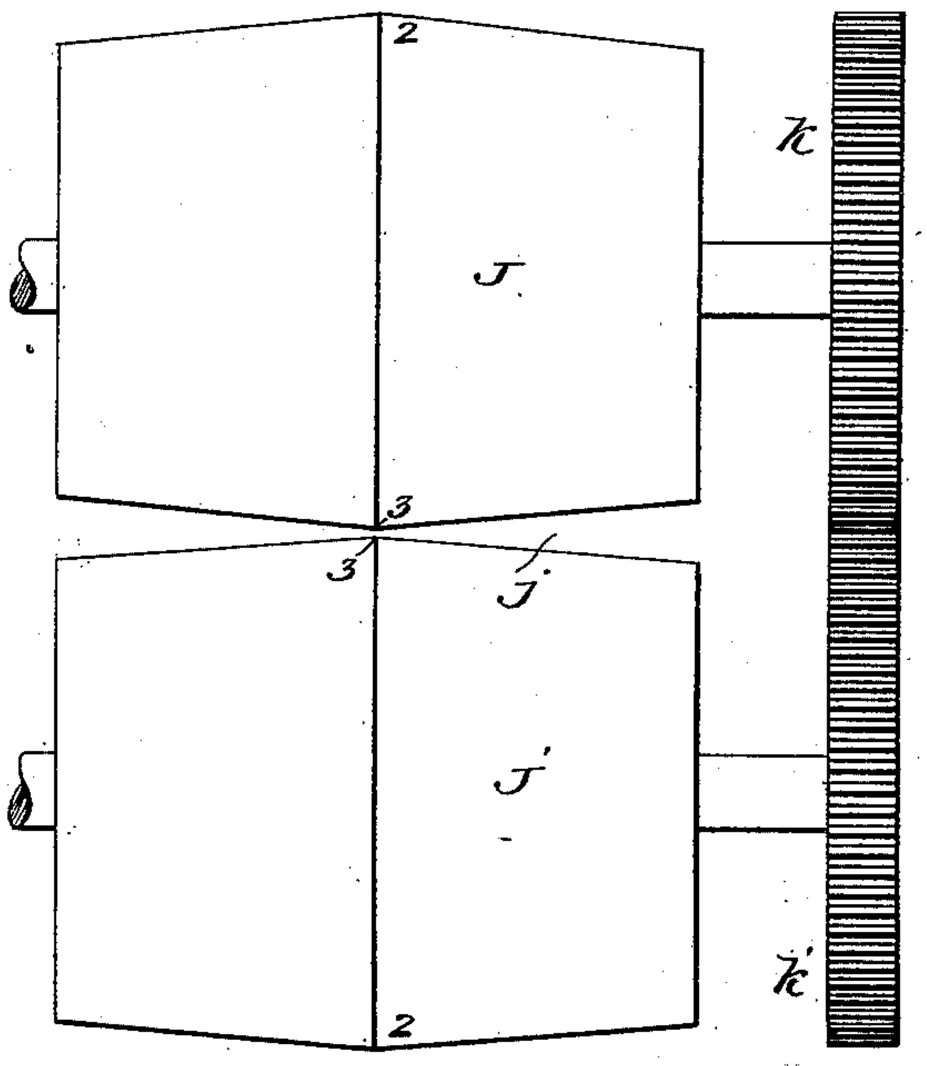
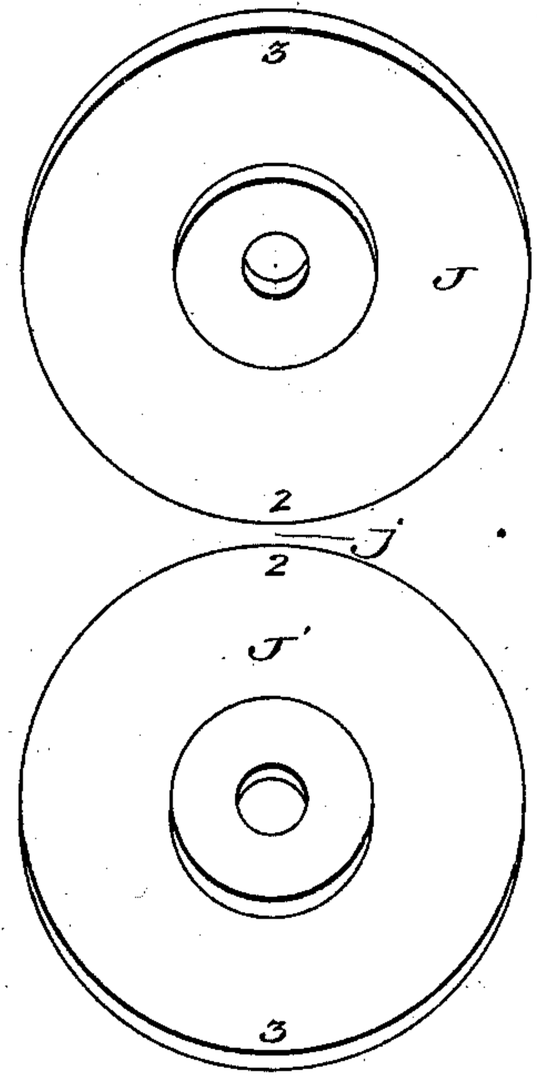
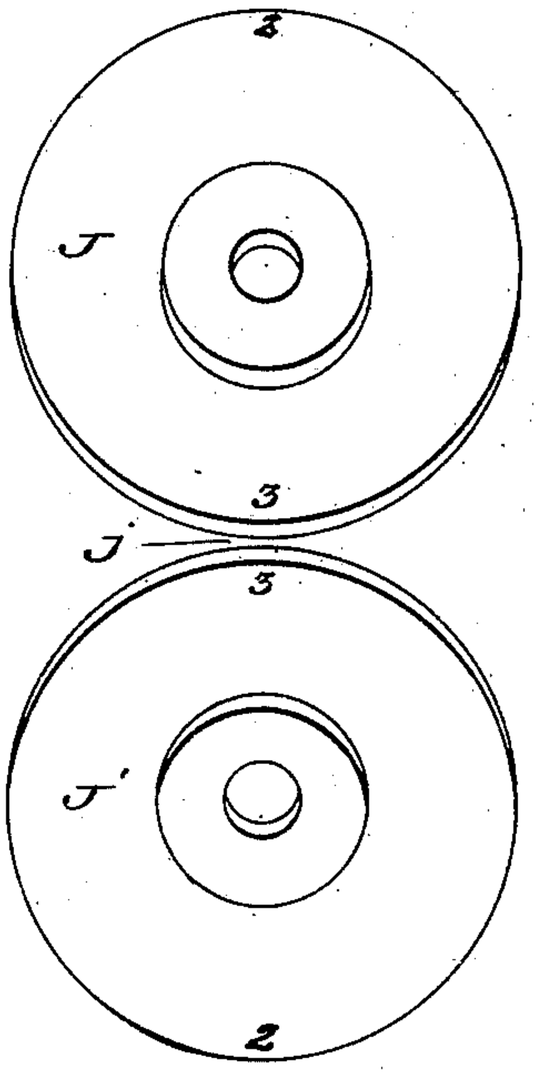


Fig. 15.





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(No Model.) 5 Sheets—Sheet 5.

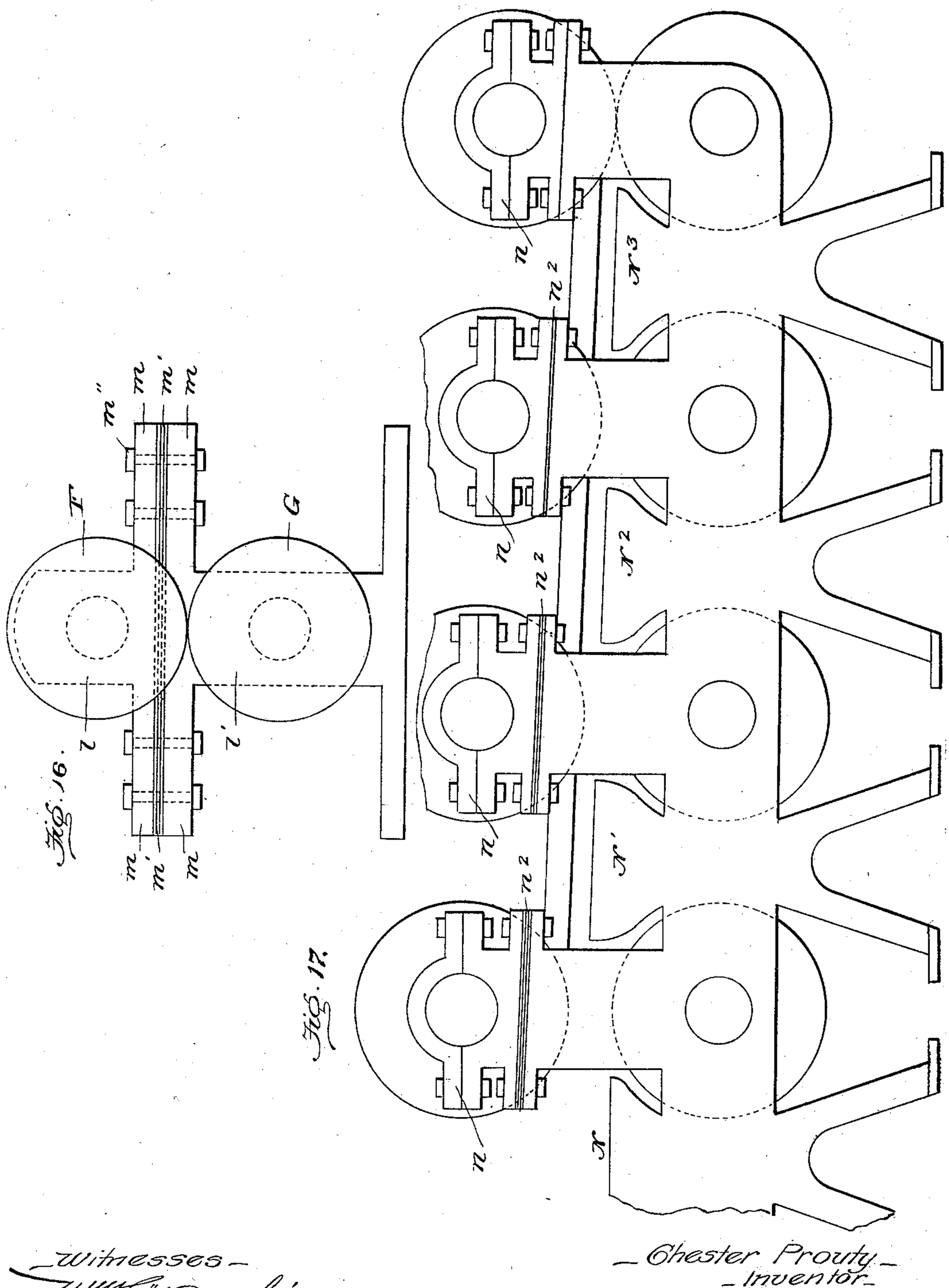

Fig. 16.

Fig. 17.

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UNITED STATES PATENT OFFICE.

CHESTER PROUTY, OF DUBOIS, PENNSYLVANIA.

APPARATUS FOR ROLLING TAPERING METAL FOR SAWS OR THE LIKE.

SPECIFICATION forming part of Letters Patent No. 671,450, dated April 9, 1901.

Application filed March 3, 1896. Serial No. 581,658. (No model.)

To all whom it may concern:

Be it known that I, CHESTER PROUTY, a citizen of the United States, residing at Dubois, in the county of Clearfield and State of Pennsylvania, have invented certain new and useful Improvements in Apparatus for Rolling Tapering Metal for Saws and the Like; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

Heretofore in the manufacture of steel blanks for crosscut-saws, which require to be of tapering longitudinal and cross-sectional contour, it has not been practical to roll out a steel plate to produce a shaped blank of tapering longitudinal and cross-sectional form suitable for use, because in rolling such steel plates with parallel or inclined rolling-mills under the old and well-known processes the plate would be convexed on its thin edge in proportion to its additional thinness and concaved in its thick edge in proportion to its additional thickness. In case a plate such as one having the convexed thick and thin edges is held in "liners" to roll it straight the thin edge has irregularities or "kinks" in proportion to its additional length and the thick edge would be comparatively straight, which results are due to the pressure of the steel lengthwise and transversely to produce the thinness desired in a plate for use as a blank. In this art attempts have been made to roll a blank by the employment of a mill having its rolls set obliquely or inclined to each other in order that a taper may be rolled in the blank transversely across the longitudinal axis thereof; but it has been found impossible to successfully roll blanks with a mill of this character because the blank cannot be guided or directed in a straight line through the rolls, but will swing or feed in an arc of a circle. Hence such attempts have been failures. This is due to the excess of roll-pressure on one side of the blank required to reduce the metal to the necessary thinness or gage, which results in flattening out the steel both longitudinally and transversely to such an extent that the central portion of the plate is forced or bulged out edgewise in excess of the end portions of the blank, thus leaving the thin edge convexed and the thick edge concaved and making the blank wholly unfit for use in the manufacture of cutlery or saw-blades. The failure to produce by the rolling process blanks which are suitable for the manufacture of crosscut-saw blades, for handsaws, and other tapering metal articles has resulted in the adoption of flat steel rolled to even gage of thickness suitable for the work and in the forging or grinding of the blanks to secure the desired taper therein. The subsequent treatment of the rolled blanks is objectionable for many reasons, chiefly because of the increased cost in the production of the blanks due to the necessary labor expended thereon, and particularly is this true with reference to the treatment of blanks by grinding the same, which method is now almost universally in vogue among saw manufacturers. The grinding of saws to the desired gage and taper is attended by many difficulties and involves the expenditure of much time, labor, and waste of material, both of the running-stone and of the steel, and results in many instances in the production of imperfect blades due to the variation in the temper of the blade at different points throughout the length thereof.

The object that I have in view is to overcome these difficulties in the art of rolling blanks of tapering longitudinal and cross-sectional form suitable for use in the manufacture of saw-blades, cutlery articles, and other tapered metal articles and to provide improvements which result in the economical manufacture of superior tapered blanks in an expeditious manner.

It is desirable in crosscut-saws to produce a blank which shall be of varying gages or thicknesses at different points throughout its length and width—as, for instance, the convex cutting edge of the blade may be of increased thickness or lower gage at the middle than at the ends thereof, while the neutral back edge may be of increased gage or less thickness at the middle than at the ends. Such a saw I have shown and described in a prior application for Letters Patent of the United States filed by me February 12, 1894, Serial No. 499,951.

It is proper here to state that the gage members used in measuring the thickness of the

blades run inversely to the numbers used in measuring by inches the thickness of ordinary iron or steel plates—that is to say, in saw-gages ascending numbers indicate diminishing thickness, while in ordinary measuring by inches ascending numbers indicate increasing thickness. This explanation is made to avoid confusion and to give a clear understanding of the signification of the numbers used on the drawings, and which will be hereinafter more particularly referred to.

For the production of plates having a double-tapered cross-sectional form suitable for manufacture of blanks for saws, cutlery, and other tapered metal articles I employ rolls of peculiar contour. These rolls have their working surfaces sloping in opposite directions from the middle thereof, or, in other words, the rolls are of greatest diameter at or about the middle portion thereof and are of less diameter at the end portions, whereby a pass is provided by and between the rolls which is of less width at its middle portion than at either of its end portions. A further peculiarity which is characteristic of my newly-invented set of rolls is that the peripheral working surfaces at certain portions are eccentric to the roll-axes, and the rolls are so arranged relative to each other and are so geared as to bring the eccentric portions of the working surfaces opposed to each other during each revolution of said finishing-rolls. This conformation of the rolls and the mode of arranging and gearing them causes the pass or space between the rolls to be of different thicknesses or widths at different times during each complete rotation of the rolls. Thus when the rolls are turned to bring the eccentric portions opposite each other the pass is wider at all points than it is when the other or eccentric portions of the rolls are opposed to each other, whereby the rolls are made to produce a blank which in addition to having a double taper in cross-section is also of different gages or thicknesses along its median line or its two side edges.

My invention further consists in the combination and construction of parts comprising the apparatus for producing steel blanks, which will be hereinafter fully described and claimed.

To enable others to understand my invention, I have illustrated different forms of the blank and different types of rolls for producing the blank in the accompanying drawings, forming a part of this specification, and in which—

Figures 1 and 2 illustrate perspective views of one type of my plate as it comes from the rolls, in each of which the gage or thickness along its thick and thin portions is uniform, as indicated by the gage members; and Fig. 3 is a view of the blanks produced by severing the plate longitudinally along its middle on the dotted line of severance. Fig. 4 is a view of a flat plate, of rectangular form and of uniform gage, from which the plate of Figs. 1 and 2 may be rolled. Fig. 5 is a type of shaped plate suitable for making a saw with a convex edge. Figs. 6 and 7 are views of rolls with passes of different forms to produce a plate substantially as shown by Figs. 1 and 2. Figs. 8 and 9 are views of a plate rolled from a prepared steel billet having the proper contour to produce four crosscut-saw blades and with different thicknesses or gages at different places throughout the length and width thereof, as indicated by the gage members; and Fig. 10 is a perspective view of a prepared steel billet from which the plates of Figs. 8 and 9 may be produced. Fig. 11 is a view of another form of plate rolled from a flat straight piece of steel, the dotted lines indicating the lines of severance and the lines on which the blanks are trimmed after the plate has been cut longitudinally and transversely to give the blank the proper contour for manufacture into crosscut-saw blades. Figs. 12 and 13 are elevations looking at the side and end, respectively, of a set of finishing-rolls for producing the plates shown by Figs. 8, 9, and 11, showing the pass when the rolls are in one position. Figs. 14 and 15 are similar elevations with the rolls in the reversed position or when they have made a half-revolution, so that the rolls form a pass which is of less width at all points than the pass made by the rolls when in the position shown by Figs. 15 and 16. Fig. 16 is a view of a set of finishing-rolls, showing the construction by which the rolls may be adjusted relatively to each other. Fig. 17 is a view illustrating a gang of rolls for successively reducing the bar to the desired form by giving the embryo blank the proper contour and gages, showing the means by which the rolls may be adjusted to regulate the sizes of the passes.

Like letters of reference denote corresponding parts in all the figures of the drawings.

A designates the plate, which is rolled with a thin longitudinal central portion (indicated at *a*) and with two thick edges at *b c*, producing a plate which is tapered from both sides inwardly toward the median line *a*. To produce two blanks, the plate is cut or severed along its thin middle portion, the line of severance being indicated by the dotted line *d*, the two halves of the plate forming the two blanks B C. (Shown by Fig. 3.) The rolled plate A may be produced from a flat rectangular bar of the form shown at D in Fig. 4 or it may be produced by rolling a prepared billet having curved side edges. The plate A has its side edges of uniform thickness or gage along its length, as indicated by the gage-numbers 13 in Fig. 1 and by the gage-numbers 14 in Fig. 2, while the thin middle part *a* of said blank is of uniform thickness throughout the length of the blank, as indicated by the gage-numbers 22 in Fig. 1 and by the gage-numbers 18 in Fig. 2. By cutting the plate of either Fig. 1 or Fig. 2 along its median line the two blanks B C are

produced, each having a uniform gage along its thin edge and a uniform but decreased gage or increased thickness along its opposite edge. Such a blank is well adapted for the manufacture of tapered saws, handsaws, knife-blades, cutlery articles, or any other article requiring a taper form, and in the operation of rolling the plate A from which the blanks are produced the plate is free from prolongation along one edge and of irregularities or kinks along its thick edge, which defects have been the serious objection to plates which can be produced with the common type of rolls.

Crosscut-saws are generally and preferably made with convex thickened cutting edges, and in Fig. 5 a rolled-out or prepared plate E for two crosscut-saws is shown. This plate E is rolled from a prepared billet of steel, said billet having curved side edges. The billet or plate is first passed through ordinary rolls to reduce it to a suitable thickness or gage and it is then fed to the pass or passes in the set or gang of finishing-rolls, whereby it is flattened out and elongated both transversely and longitudinally by the finishing-rolls, so as to produce a plate having the double-tapered cross-sectional form similar to the form shown by Figs. 1 and 2, and said rolled plate has the curved side edges of proper gage. When the plate E is cut longitudinally to produce two blanks, each blank has a straight thin back edge and a thickened curved cutting edge. The teeth of the saw are to be cut in the thickened convex edge of the blank.

Different styles of rolls for finishing the prepared plate A or E are illustrated in Figs. 6 and 7; but there is a generic feature common to all of these rolls. It should be understood that the plate or billet is first reduced to the desired gage or thickness, and it is then passed through the finishing-rolls to give it the desired shape preparatory to cutting the plate into blanks. Each set of finishing-rolls (shown by Figs 6 and 7) consists, preferably, of the two rolls F G, each of which has a central portion or ridge *f* at its middle and is tapered toward the ends, so that the two ends of the roll are of less diameter than the central ridged portion *f*. The rolls F G have their shafts or trunnions journaled in suitable bearings, and they are arranged, preferably, one below the other, so that the lines of greatest diameter or the ridged portions *f* of the two rolls F G are opposite to each other, thereby forming a pass *g*, which is of less depth or thickness at its middle than at the two sides or ends. The rolls shown in Fig. 6 have annular end flanges *h*, which ride or travel together and furnish end bearings for the rolls; but these flanges may be omitted, as in Fig. 7. The rolls shown by Fig. 6 are set a little farther apart than the rolls shown in Fig. 7 to make a wider pass *g*, suitable for making the plate A shown by Fig. 1, while the rolls of Fig. 6 are suitable for making the plate A of Fig. 2. Otherwise the rolls are the same.

It is to be understood that the gage-numbers used on Figs. 1 and 2 are merely illustrative of two types of plates, which may have different lines of thickness or gage along their two edges; but my invention contemplates the production of plates, such as A E, having other thicknesses or gages than are indicated in the examples illustrated as embodiments of my improvements.

The rolls of Figs. 6 and 7 for producing the plate A or E, in which the thicknesses or gages are uniform along the side edges and the central portion, are prepared by turning the working face of each of the rolls concentric with the roll-axis at all points and by beveling the working face of the roll longitudinally from its central or ridged portion *f* toward both ends, the inclination of one half of the roll being reverse to the line of inclination on the other half of the roll.

In the manufacture of special crosscut-saw blanks or other specially-tapered blanks for other articles with different gages or thicknesses along either or both the front and back edges of the blank special styles of plate and special types of rolls are necessary. While the plates and rolls which I have invented for this purpose embody the same leading principles as the plates and rolls hereinbefore described, yet the rolls have other peculiar characteristic features of construction which enable them to produce plates G H having the different thicknesses or gages indicated by the gage-numbers in Figs. 8 and 9 or Fig. 11.

The billet H′ for producing the quadruplex blank shown by Fig. 10 is a double prepared billet, each half of which has the longitudinal contour for producing two convex-edged saw-blanks.

The plates G H of Figs. 8 and 9, produced by rolling out the duplex billet of Fig. 10, are each adapted to be cut transversely on the line of severance indicated at *g*′, and each length has the curved side edges of a proper contour to form the convex cutting edges of two crosscut-saw blanks. Each length of metal has the thickened side edges and a thin central portion, as in Figs. 1 and 2; but in these forms of plates G H the gages are not uniform either on the edges or middle portion. Thus in Fig. 8 the gage of the side edges at the middle is fourteen and at the ends fourteen and a half. The gage along the central median line is at the middle twenty and at the ends of the length or plate nineteen, as clearly indicated. In Fig. 9 the gages or thicknesses vary along the central or median line of the blank from twenty at the middle of each length to eighteen at the ends, while the gages on the ends are or may be uniform, as at 14. These gages, however, are merely illustrative and they may vary as widely and relatively as desired by the skilled mechanic.

The plate G H, with the different gages or thicknesses at its central portion and side edges, is adapted to be produced after it has been reduced to the proper gage by ordinary rolls from either a prepared billet or straight bar by a set of finishing-rolls J J′, which set is illustrated in one position by Figs. 12 and 13 and in a reversed position by Figs. 14 and 15. In producing rolls such as J J′ for rolling and finishing irregular plates such as described I form the working surfaces of each roll with the reverse tapers from the middle toward the ends of the roll, and thereby make the pass *j* between the rolls of the desired shape, with a narrow center and wide ends; but the peripheral working surface of each roll is not concentric with the roll-axis, as in Figs. 6 and 7, but said working surface is turned off eccentric to its axis, so that the points 2 3 are at different distances radially from the axis of the roll. In turning the roll, if it is desired to have the eccentric point 2 a distance from the roll-axis equal to one gage in the saw-blank, the center of the turning-tool is shifted on the roll-trunnion a distance equal to one gage and then the surface of the roll is turned up true to both ends. To roll a six-foot saw-blank, the rolls J J′ are each made twenty-four inches in diameter, so that it only requires one revolution of the set of rolls to roll out and finish two saw-blanks. On the trunnion or end of the roll-shafts are mounted the intermeshing gears *k k′*, which insure simultaneous and positive rotation of the pair of rolls in opposite directions, and these rolls are arranged relative to each other to insure the eccentric portion 2 2 coming opposite to each other at one point of the revolution of said rolls, while the other portion 3 3 of the rolls come opposite to each other at the next half-revolution of the rolls. When the rolls J J′ occupy the position shown by Figs. 12 and 13, the portions 2 2 are opposite to each other and the pass *j* between the rolls is quite wide at its middle and sides; but when the rolls make a half-turn and the portions 3 3 of the rolls are opposite the pass *j* is narrower both at its middle and sides, as shown by Figs. 14 and 15 and which will be readily understood by a comparison. The steel bar or billet is fed to the rolls when they are farthest apart or the pass *j* is widest, as in the position shown by Figs. 12 and 13. As the rolls turn they press the steel or flatten it out to a shape the reverse of the faces of the rolls, and when the rolls have made a half-turn the portions 3 3 thereof exert greater pressure on the steel, after which in the continued rotation of the rolls the pressure is relaxed, so that by the time the rolls have made a complete revolution the plate is rolled out to produce two or more complete blanks. In the operation of passing the bar or billet between the rolls the metal is elongated in the direction of its length and width, and it is shaped, at least approximately, to give it the curved contour on its side edges, and at the same time the different thicknesses or gages are imparted to the plate according to the contour and eccentricity of the working surfaces of the rolls.

The rolls for producing the shaped plate may consist of a single pair of finishing-rolls, as shown by Figs. 6 and 7 or in Figs. 12 to 15, inclusive, in which event the plate or billet is previously reduced by ordinary rolls to a suitable gage or thickness, or said rolls for preparing the plate may be embodied in a gang of rolls, the passes in which are successively narrower or smaller to effect the gradual reduction and shaping of the metallic bar or plate, such a gang of rolls being shown by Fig. 16 of the drawings. When the rolls have once been prepared or turned, as described, they may be used to roll out shaped plates having different gages or thicknesses, which can be accomplished by setting the rolls at different distances from each other to vary the width of thickness of the pass. In Fig. 16 is illustrated a convenient construction by which this adjustment of the rolls to vary the size of the pass may be secured. The side frame for the roll-journal bearings is made in two sections *l l′*, which have the horizontally-extending arms *m*, between which is interposed one or more liners or adjusting-plates *m′*, said arms and the plates being clamped rigidly together by the through-bolts *m″*. The gang of rolls shown by Fig. 17 are also capable of adjustment to vary the sizes of the passes by fitting the top-roll journals in cap-boxes *n*, which may be raised or lowered by fitting one or more liners or adjusting-plates n^2 between the standards and the boxes. It will be noted that the last roll set of gang does not require the use of liners; but the other roll sets have liners of gradually-increasing thicknesses, so that the passes are successively narrower from the first roll set to the last or finishing set of rolls.

In rolling out a billet or plate to produce the tapered blank in accordance with my invention by the gang of rolls shown by Fig. 17 of the drawings suitable guides N N′ N^2 N^3 are employed between the sets of rolls and in front of the first set of rolls. These guides are planed off smooth and true with relation to the passes between the rolls, and they may be made adjustable in any suitable way to correspond with the adjustments of the rolls. These guides operate to keep the steel billet or plate from "lopping" down or being depressed between the rolls and from running sidewise, so that the billet or plate is fed straight and true between and through the rolls. Each set of rolls may have the contour or shape shown by Figs. 6 or 7 or by Figs. 12 to 15, inclusive, or only the last two may be the finishing-rolls, and the successive sets of rolls from the first set to the last set are to be set apart to produce passes, which are successively narrower or smaller from the first to the last set of rolls. When the steel billet or plate is fed to the first flat rolls, it

is narrow and thick, and as it passes through said first rolls it is increased in length and width, but reduced in thickness. The guide N′ between the first and second rolls is of proper height to receive the plate as it emerges from the first rolls. As the plate passes through the second flat rolls in the gang, the rolls operate to further reduce the thickness of the plate and make the plate longer and wider in proportion to the pressure exerted by the rolls, and the guide N^2 between the second and third rolls corresponds to the height of the face of the lower rolls and the sides of the guide are the proper distance from each other and correspond to the width of the plate to enable said plate as it comes from the second rolls to fit upon and between the guide N^2. The plate is further reduced in thickness and increased in length and proportionately to the pressure exerted on the plate by the shaped third rolls, and these third rolls give to the plate a contour or shape opposite to the working faces of the finishing-rolls, or, in other words, the shape of the pass between the prepared third rolls. The guide N^3 between the third and fourth rolls is wider than the guides N′ N^2, and said guide N^3 is arranged on the plane of the highest point of the lower rolls of the third and fourth rolls. The guide N^3 feeds the plate to the last or fourth rolls, which rolls operate to give to the steel the proper cross-sectional form and the necessary gage or gages both longitudinally and transversely.

It will be seen that the gang of rolls gradually reduce the metal in thickness and flatten it both lengthwise and sidewise, as well as impart the desired cross-sectional form thereto, and the guides serve to properly support the metal at the intervals between the rolls and to direct it properly to the passes between the rolls.

It is to be understood that after the shaped plate has been rolled and severed to produce the blanks suitable for use in the manufacture of crosscut-saws each blank is tempered and the teeth cut on the thickened edge and that it is otherwise treated and finished to produce a marketable crosscut-saw.

Having thus fully described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a metal-rolling mill, a set of working rolls for producing blanks which taper longitudinally and cross-sectionally, each having a crowned working face arranged eccentric to the roll-axis and said rolls arranged to present the crowned eccentric faces in the same plane to produce a metal-receiving pass which is of double-tapered form and varies in the thickness during the rotation of the rolls on their axes, substantially as described.

2. In a metal-rolling mill, a set of working rolls for producing blanks which taper longitudinally and cross-sectionally, each roll having a circumferential working face which is eccentric to the roll-axis and such working surface being tapered from a central ridge uniformly in opposite directions toward the ends of the roll, and gearing operatively connecting said working rolls to insure coincidence in the high parts of the eccentric roll-surfaces and to vary the thickness of the pass, formed by the opposing crowned surfaces, during the rotation of their rolls on their axes, substantially as described.

3. A rolling-mill, substantially as described, comprising a sectional frame the members of which are provided with coincident abutting flanges and liners interposed between and united to the coincident flanges, and a set of coacting rolls journaled in the respective members of said frame for adjustment relatively to each other, said rolls having the eccentric and double-inclined working faces for producing a blank which tapers both cross-sectionally and longitudinally, substantially as described.

4. A rolling-mill consisting of a bed, the sectional standards each having liners clamped between the members thereof and adjusted to sustain rolls with passes of variable width successively decreasing from the initial to the final pass, sets of coacting rolls journaled in the members of said standards and with at least one set of said rolls having eccentric and doubly-inclined working faces, and guides all lying in the same horizontal plane with relation to the variable passes between the successive sets of rolls, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

CHESTER PROUTY.

Witnesses:

LILLIAN M. DE MOTT,

MINNIE SPARKS.