2 Sheets—Sheet 1.

J. HEMPHILL.

Steel Blooming and Slabbing Mill.

No. 232,713. **Patented Sept. 28, 1880.**

Fig. 1.

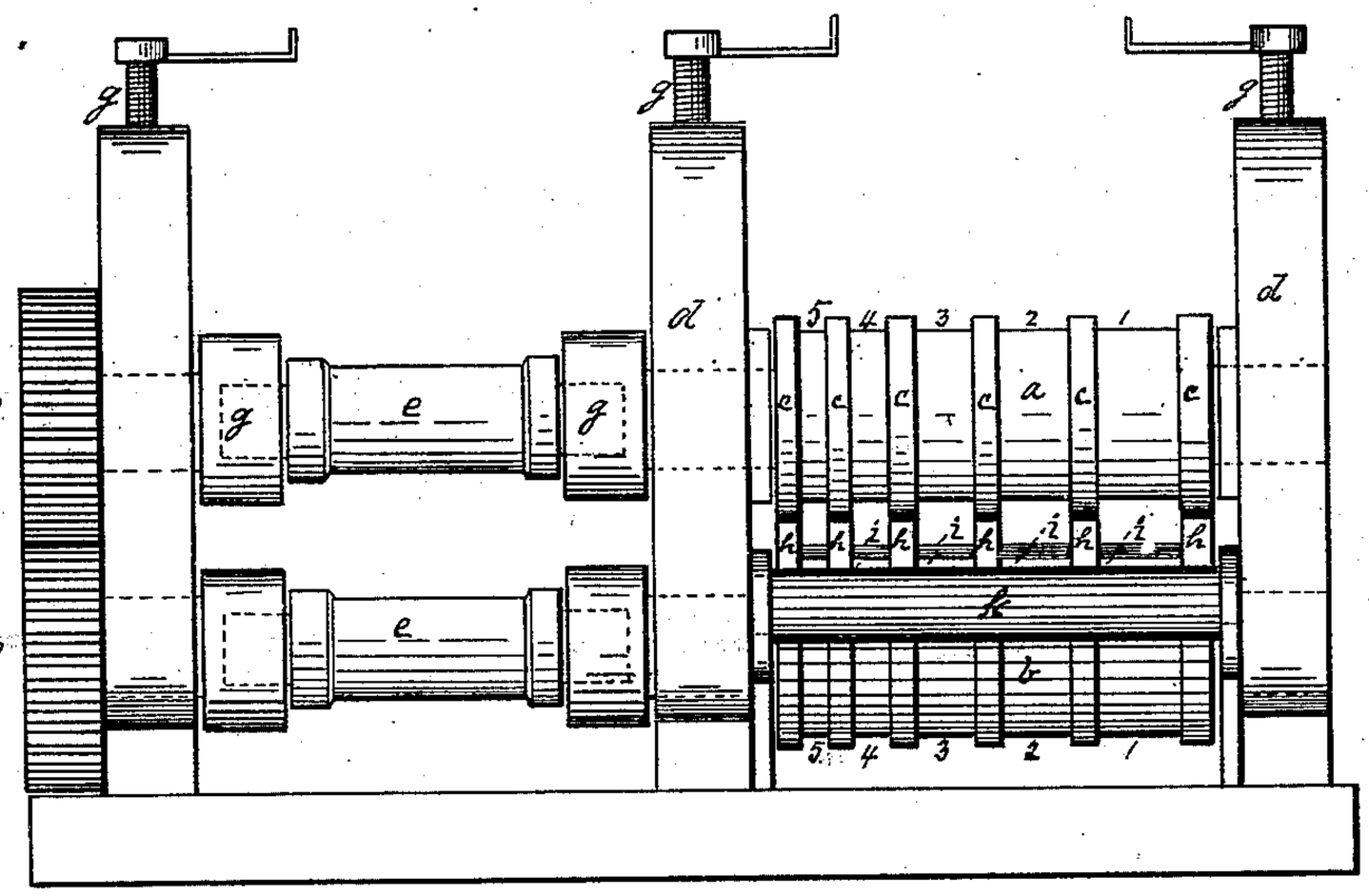
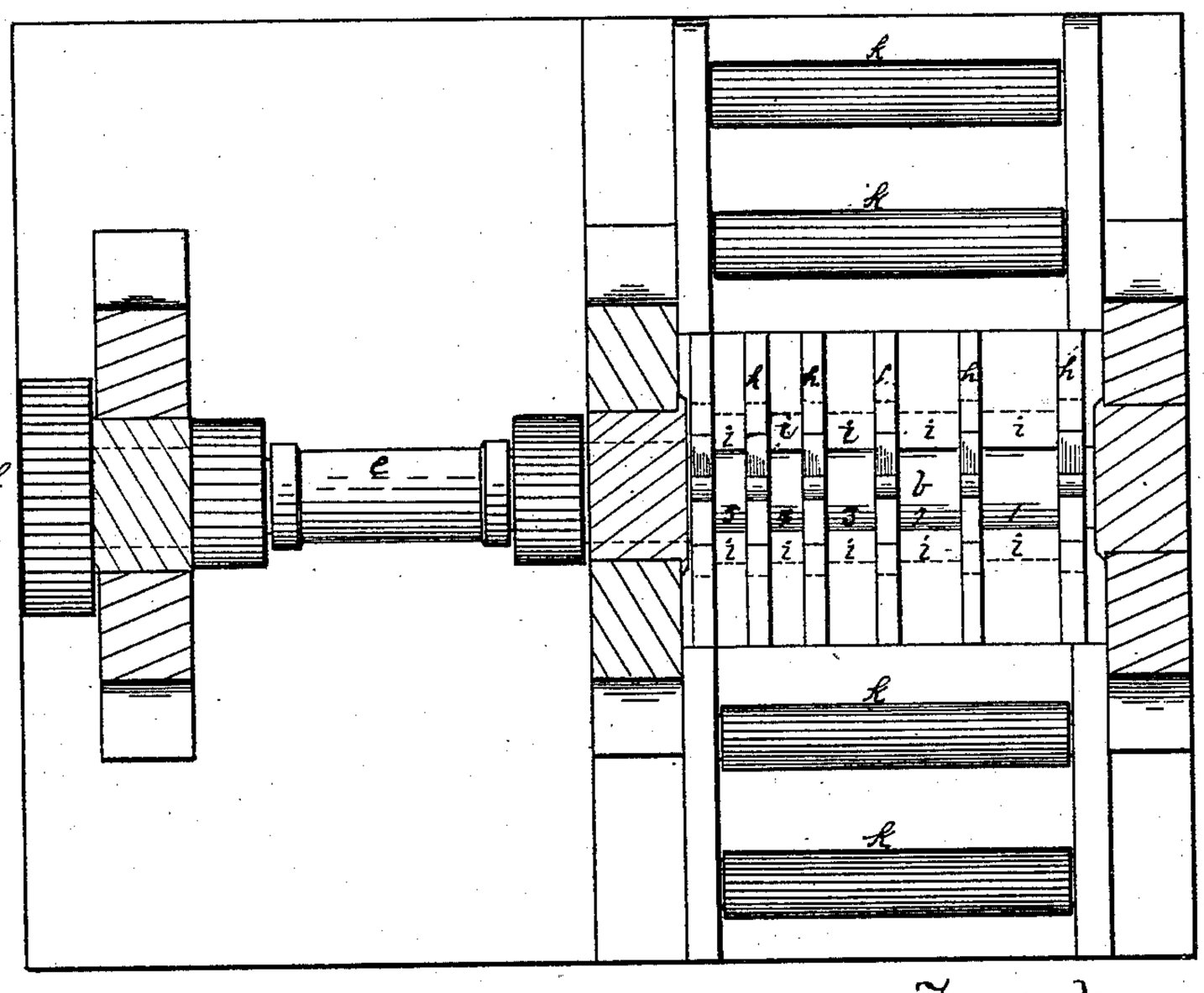


Fig. 2.



Witnesses
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L. C. Fitler

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2 Sheets—Sheet 2.

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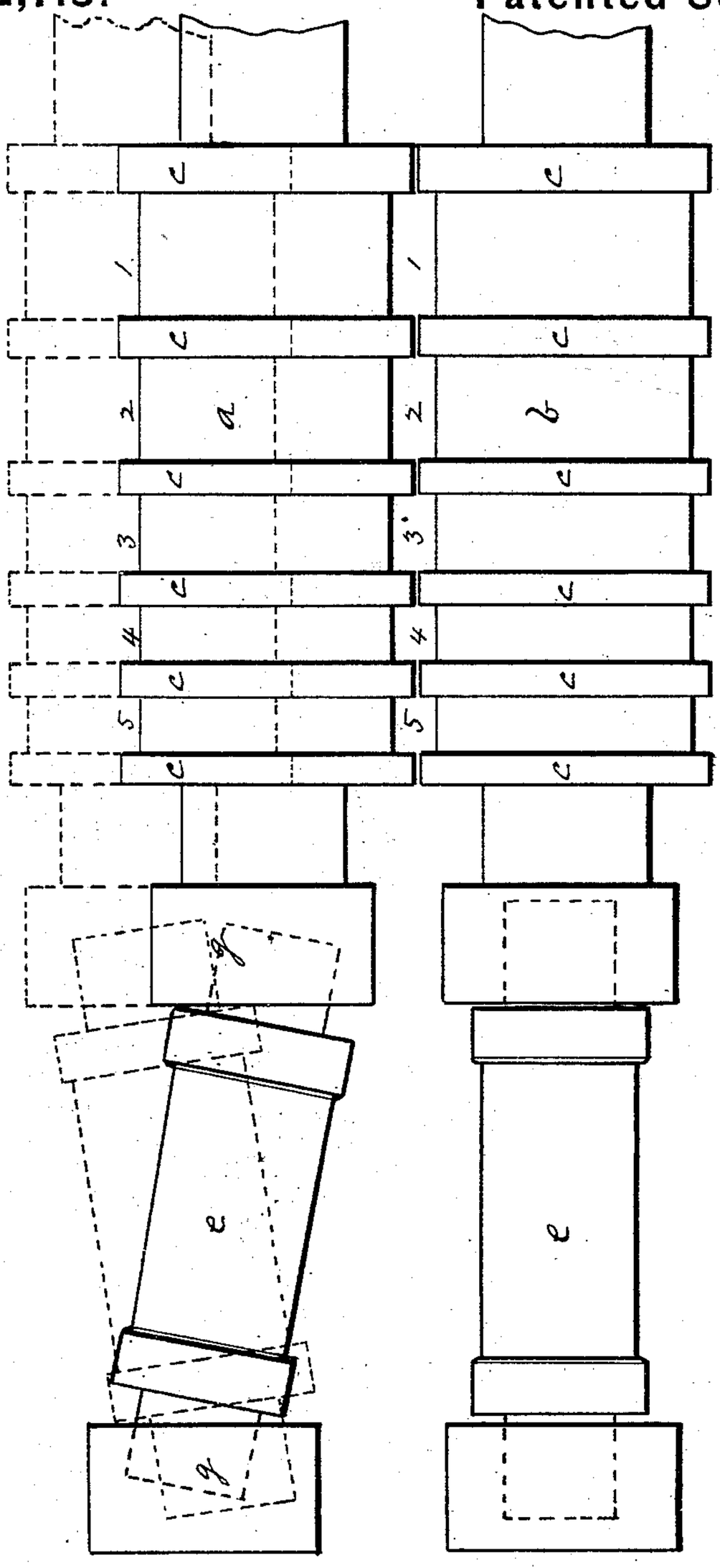

Fig. 1.

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UNITED STATES PATENT OFFICE.

JAMES HEMPHILL, OF PITTSBURG, PENNSYLVANIA.

STEEL BLOOMING AND SLABBING MILL.

SPECIFICATION forming part of Letters Patent No. 232,713, dated September 28, 1880.

Application filed December 9, 1879.

To all whom it may concern:

Be it known that I, JAMES HEMPHILL, of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Steel Blooming and Slabbing Mills; and I do hereby declare the following to be a full, clear, and exact description thereof, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a side elevation of my improved mill. Fig. 2 is a plan view, partly in section; and Fig. 3 is an outline elevation of the rolls and spindles, showing their positions in different adjustments of the rolls.

Like letters of reference indicate like parts in each.

Heretofore mills, as usually constructed for rolling steel ingots into blooms and slabs, and especially in rolls for producing square bars, have been made with the different grooves turned to the width and depth of the different sizes to be made, or nearly so—that is to say, the first groove, or the groove in which the first pass is made, would be quite deep and cut equally in both rolls, and the other grooves of gradually-reducing size. This required the guards and points or guide-boxes to be of unequal heights and the feed-rolls to be of taper form, or larger at one end than the other, so as to bring the ingot, bloom, or slab to the proper height with the grooves, in order that it might be properly fed to and delivered by the rolls. Thus to reduce an ingot twelve inches in diameter to a bar four inches square would require the rolls to have five grooves, the first being of size (in inches) twelve inches wide and ten high, the second ten by eight, the third eight by six, the fourth six by four, and the fifth four by four. The first groove would be cut about four inches in each roll, the space between the rolls giving the remainder of the height. The other four grooves would be of less depth, reducing gradually to the last. In each groove the ingot would be given three passes, more or less. The handling the ingot in such rolls, owing to the different heights of the guide-boxes, is very laborious, and the expense of the rolls and the power required to operate them are very great.

I have found by actual test that it is not necessary for the collars of the grooves to be high enough to support the entire side of the bloom or slab, and that the steel, if supported at the corners, will not spread over a low collar, as is the case with iron. Furthermore, in mills as usually constructed the spindles are geared at the power end in such a way that at the first pass the upper spindle stands at its greatest inclination. At each subsequent pass the upper roll is screwed down nearer to the lower one, and this reduces the angle of the spindle until at the last and easiest pass it is in a horizontal position and parallel to the lower spindle. The hardest work is on the mill during its middle pass or passes. The greatest reduction is probably in the first pass, owing to the fact that the metal just coming from the furnace is at a flush heat, soft and spongy, and full of cinder. The cinder is removed by the first pass or passes, and then during the middle passes the rolls have to work on the compressed and rapidly-cooling bloom or slab. The last pass or passes, being finishing rather than reducing passes, are comparatively light and easy on the rolls. Consequently it is desirable to get the greatest power of the rolls during the middle passes.

An angling position of the upper spindle produces great friction and loss of power. To secure the absence of friction during the middle passes I increase the size of the pinions, making them of greater diameter than the rolls at the collars.

If the pinions are not larger than the diameter of the rolls at the collars, it is evident that the spindles will be parallel only when the upper roll is screwed down until the collars meet, and that will occur only at the last pass. If, however, the spindles are to be parallel during the middle pass, when the rolls are considerable distance apart, the size of the pinions must exceed the size of the rolls at the collars in order that they may gear properly.

My invention consists of an improved construction of the mill, wherein I make the grooves with low collars and all of the same depth, the depth of no groove of the series in each roll exceeding half the width of the final or finishing groove, and am thereby enabled to have the guards, points, and feed-rolls on an even level, and the latter of equal diameter

throughout, and by it I save in the labor of handling and feeding the ingot, in the construction of the rolls, in power, wear, and tear, and am able to roll both blooms and slabs of different sizes in the same mill; and it also consists in the manner of gearing the driving-spindles, whereby the greatest power is obtained at the middle passes, where it is generally required.

To enable others skilled in the art to make and use my invention, I will now proceed to describe its construction and manner of use.

I first construct a pair of rolls, *a b*, in the usual way, and for a mill reducing to a four-inch square bar I cut in each roll a number of grooves—say five, 1, 2, 3, 4, 5—each having a depth of two inches, and having the following widths—viz., groove 1, twelve inches; groove 2, ten inches; groove 3, eight inches; groove 4, six inches; and groove 5, four inches. This grooving produces low collars *c*, all of the same height between the grooves.

The rolls are placed in suitable housings *d*, and are provided with spindles *e*, having pinions *f*. The lower roll, *b*, is set in fixed bearings, while the upper one, *a*, is in sliding bearings, which are provided with suitable adjusting-screws *g*.

The grooves being of the same depth, the guards *h* and points *i* are on a level with each other, and the feed-rolls *k* are of uniform diameter throughout, and are horizontal.

The spindle of the lower roll is horizontal, but the spindle of the upper roll is horizontal only during the middle passes. As a rule, the heaviest work comes on the rolls during the middle passes, and as the spindles work better and with less strain when horizontal, I make the pinions *f* larger than the rolls at the collars, and of such size that when the upper spindle, *f*, is straight and parallel with the lower one, the rolls are at proper gage for the middle passes. Then in their adjustment they are moved only a limited distance above and below the central plane, which enables the work to be done with a more nearly horizontal spindle than the prior forms, in which the horizontal position of the spindle was at the lowest adjustment and the easiest pass instead of the middle adjustment and hardest pass.

The upper spindle is movable in its coupling-boxes *g*, and is of the ordinary form used for such purpose.

The great advantage of my invention is that with a mill of this kind I can roll not only blooms of various sizes, but also with the same mill slabs of the widths of the various grooves except the first. Thus, in the illustration given I can either roll blooms or slabs in each one of the various grooves, so that the same mill which is used for making blooms of various sizes may at the same heat be used for making slabs in either the grooves 2, 3, or 4, of ten, eight, or six inches wide, and of any thickness equal to or greater than the height of the collars. This was impossible in any former construction known to me.

The purpose of the collars *c*, which are very low for the size of mill shown, is to support the corners of the blooms or slabs.

I have discovered that the tendency of the steel is to draw in at the center of the sides instead of swelling over them, as is the case with iron, and for this reason my invention is applicable to steel and not to iron.

The collars, although low, should be high enough to give a support to the corners of the bloom or slab.

In rolling a slab of ten inches width two grooves should be used, the groove 1 to square up the ingot by edge rolling and reduce it to proper size for entrance to the groove 2, in which, by repeated passes and screwing down the upper roll, it may be drawn down to a slab of ten inches wide and of any desired thickness greater than the height of the collars *c*. To make a bloom of any desired size the piece is carried down through the requisite number of grooves for that purpose.

The dimensions I have given in this description will be varied to suit the particular case in view, the purpose of the mill being considered in providing the number of grooves and the height of the collars. There should be at least two grooves, one for squaring up the ingot and the second for drawing it down.

I am aware that rolls having grooves of equal depth and varying width have heretofore been employed, and do not claim the same, for in all such cases the depth of the grooves in each roll exceeded half the width of the finishing or final groove, and squares cannot be rolled in the final groove; but

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In a steel blooming and slabbing mill, the combination of two grooved rolls, each having a series of grooves of equal depth, and the depth of said grooves not exceeding half the width of the final or finishing groove of the series, substantially as and for the purpose specified.

2. In a steel blooming and slabbing mill, two grooved rolls, each of which has a series of grooves of equal depth, the depth of the grooves not exceeding half the width of the final or finishing groove of the series, and one of said rolls being vertically adjustable, in combination with each other, and with pinions which exceed the rolls in diameter, substantially as and for the purpose specified.

In testimony whereof I, the said JAMES HEMPHILL, have hereunto set my hand.

JAS. HEMPHILL.

Witnesses:

T. B. KERR,

JAMES H. PORTE.