2 Sheets—Sheet 1.

D. F. HARTFORD.

Apparatus for Grading Patterns.

No. 201,111. Patented March 12, 1878.

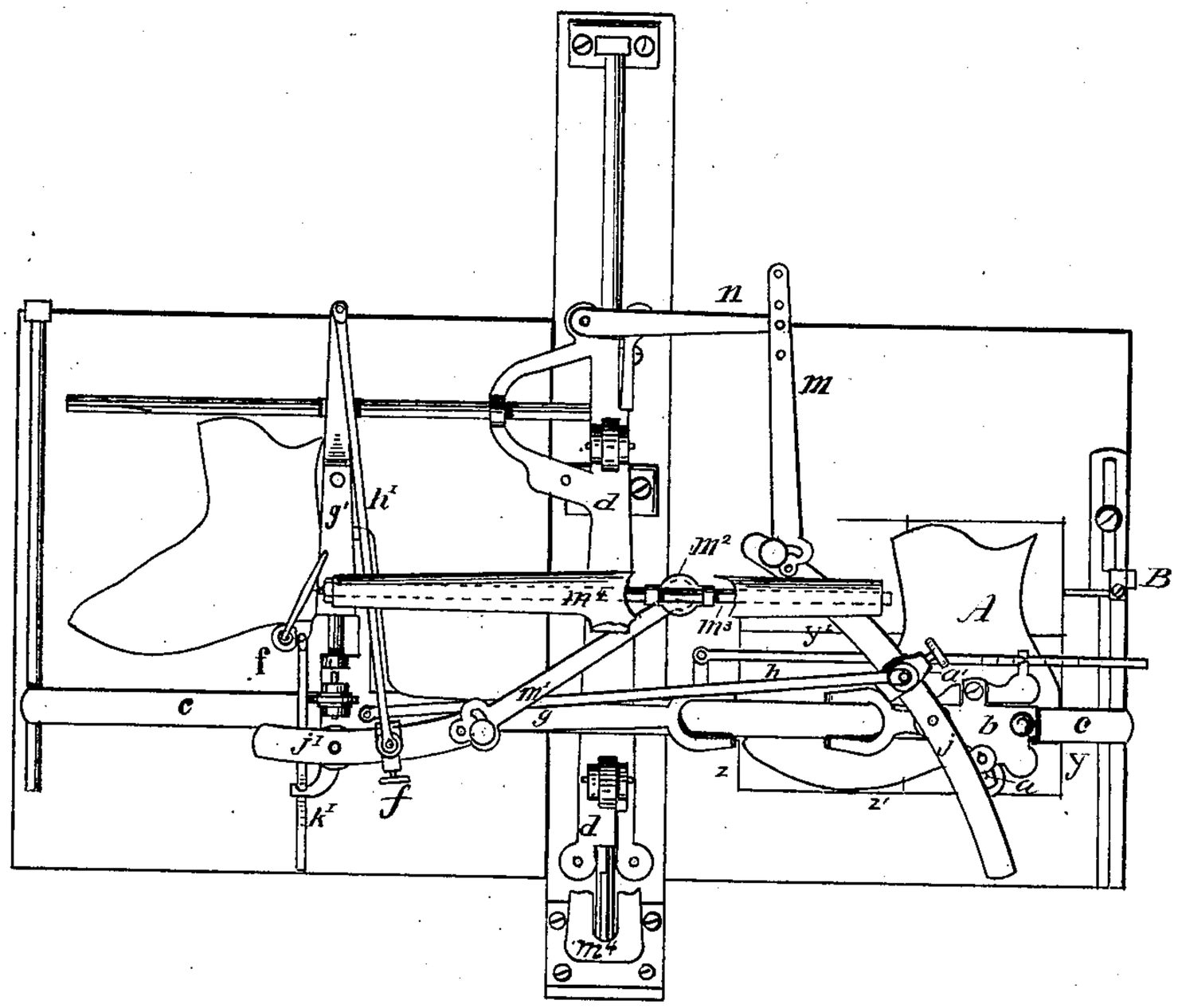

Fig. 1.

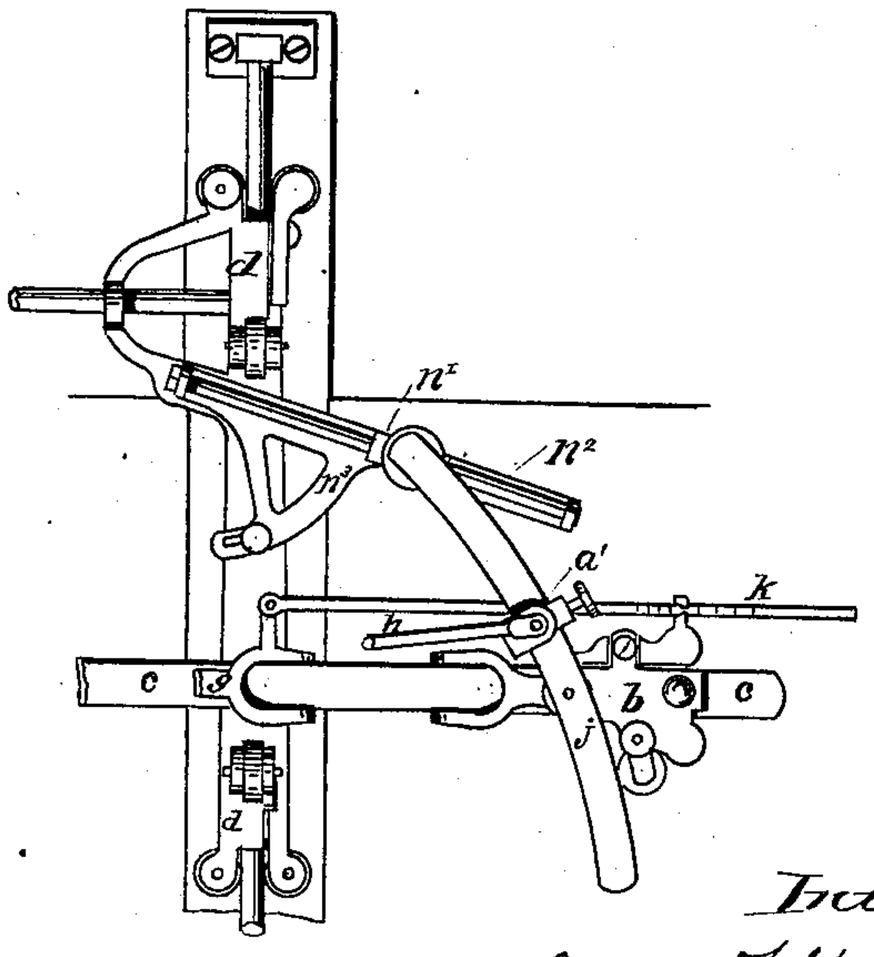

Fig. 2.

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2 Sheets—Sheet 2.

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Apparatus for Grading Patterns.

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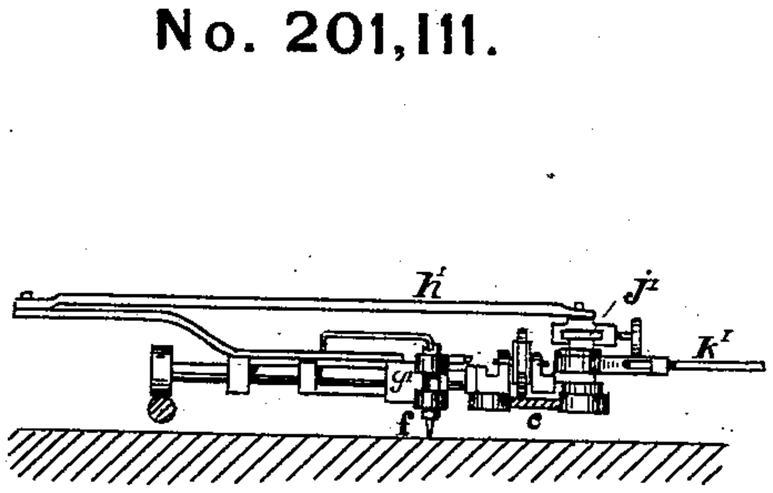

Fig. 3.

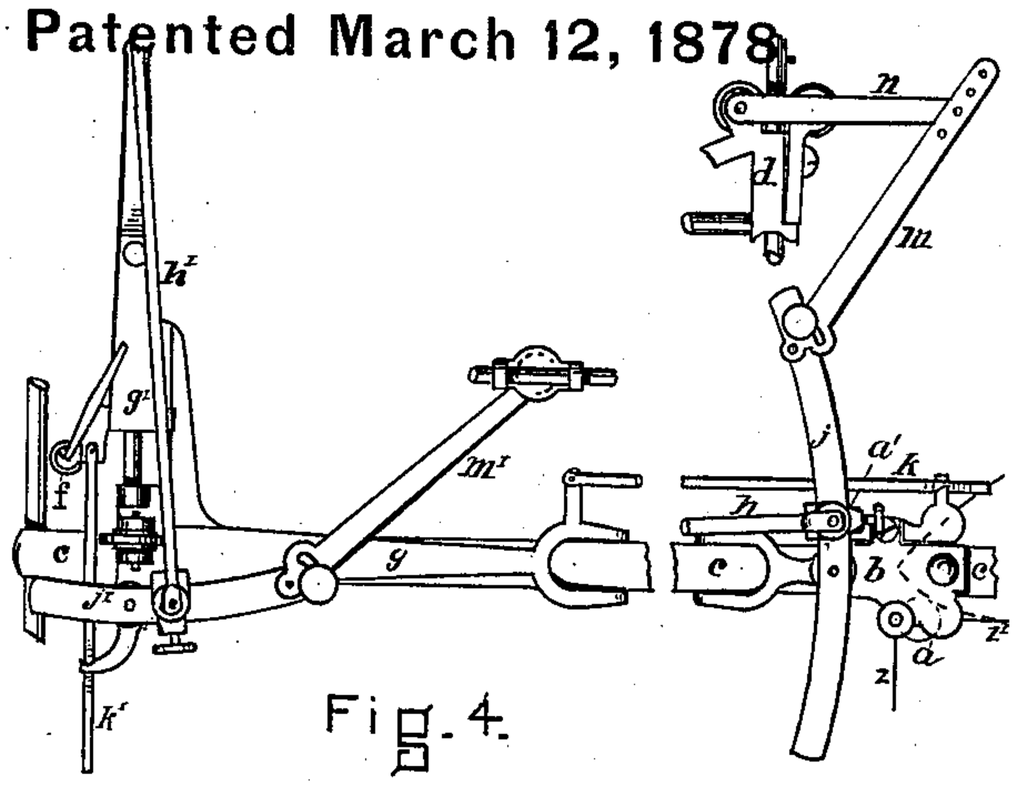

Fig. 4.

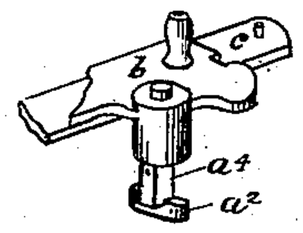

Fig. 7.

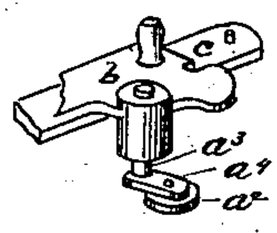

Fig. 8.

Fig. 9.

Fig. 10.

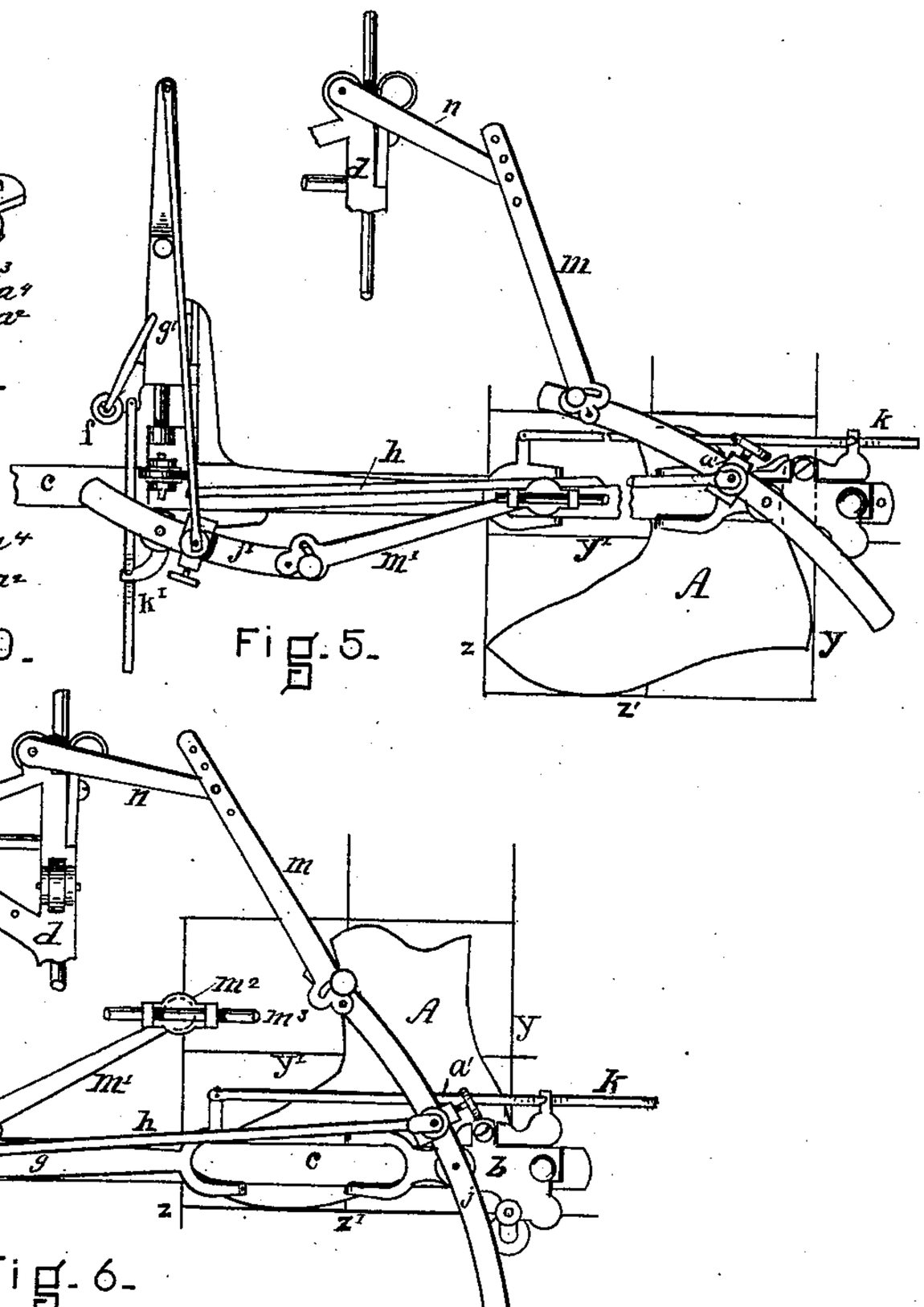

Fig. 5.

Fig. 6.

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UNITED STATES PATENT OFFICE.

DAVID F. HARTFORD, OF BOSTON, MASSACHUSETTS, ASSIGNOR OF ONE-HALF HIS RIGHT TO THOMAS T. HARTFORD, OF SAME PLACE.

IMPROVEMENT IN APPARATUS FOR GRADING PATTERNS.

Specification forming part of Letters Patent No. **201,111**, dated March 12, 1878; application filed October 22, 1877.

To all whom it may concern:

Be it known that I, DAVID F. HARTFORD, of Boston, county of Suffolk, and State of Massachusetts, have invented an Apparatus for Grading Patterns, and other like purposes, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, making a part hereof.

In the drawings, Figure 1 is a plan of an apparatus embodying all the features of my invention. Fig. 2 shows a modification of one of the devices. The other figures are designed to show more clearly the details of construction of the apparatus.

The tracer *a* is mounted upon a carriage, *b*, which is so mounted upon a support, *c*, that the tracer can be moved freely from side to side, and the support *c* is so mounted upon the support *d* that the tracer can also be moved freely from top to bottom, or up and down, thus giving the tracer a universal motion in one plane. The marker *f* is in like manner mounted so that it can run freely in any direction in one plane. Its carriage is marked *g*, and is supported upon the support *c*, so that it can be moved from side to side freely.

I have shown in the drawings both the tracer and the marker upon carriages *b* and *g*, and both these carriages sliding upon the support *c*, which is fast to the support *d;* but it is obvious that the universal motion of the tracer and marker may be provided for in other ways. For example, either of the carriages *b* or *g* might be fast to the support *c*, if that support were free to slide across the support *d;* and other devices may be readily substituted for those shown, in order to give the tracer and marker the universal motion above explained, and yet allow them to be connected together, so that the motion of one will determine the motion of the other, as now to be explained.

The tracer-carriage *b* is connected to the marker-carriage *g* by means of a radius-bar, *h*, which is centered upon the marker-carriage *g*, and adjustably connected to a cross-bar, *j*, which is centered upon the tracer-carriage *b*. When this radius-bar *h* has its right-hand axis coincident with the axis which connects the cross-bar *j* and the tracer-carriage *b*, any motion of the tracer to the right or left will cause the marker to move precisely the same distance and in the same direction, and in like manner any motion of the tracer up or down will cause the marker to move precisely the same distance and in the same direction, (if the motion of the marker be not affected by the radius-bar *h'* and cross-bar *j'*, which will be disregarded for the present.)

By this portion of the apparatus—that is, without the radius-bar *h'* and cross-bar *j'*—a figure will be marked out by the marker precisely the same as the figure described by the axis of the tracer, if the axis of the radius-bar *h* coincide with the axis of the cross-bar *j;* in other words, the two carriages *b* and *g* will always be in precisely the same relation one to the other.

The cross-bar *j* changes its position relatively to the tracer-carriage *b* with every movement of that carriage, because at one end its movement is restricted by the connecting-rod *m*, and it is thereby compelled to turn upon the axis by which it is connected to the carriage *b*. Hence (as will be clear) the size of the figure described by the machine in lines parallel with the support *c* may be made less or more than the size of the figure described by the tracer along corresponding lines by shifting the slide a^1 to one side or the other of the axis by which the cross-bar *j* is connected to carriage *b*, and the decrease or increase along these lines will depend upon the distance between the former axis and the axis by which the radius-bar *h* is connected to the slide a^1.

It is this combination of a tracer and marker by means of a radius-bar and cross-bar which constitutes the main feature of my invention, and, so far as I know or have any reason to believe, this part of my apparatus is wholly new with me. It is capable of use separately, as will be clear, in all cases where it is desired that the marker shall describe a figure either precisely the same as that described by the tracer, or a figure either larger or smaller in one direction than that described by the tracer.

The main object of my invention is to produce a series of graded patterns from a single

pattern, and the apparatus shown in the drawings is especially designed for the grading of patterns for soles and other parts of boots and shoes. As these patterns vary in size not only lengthwise—that is, in lines parallel with the support *c*—but also widthwise, in sole-patterns, or from top to bottom in upper-patterns—that is, in lines parallel with the support *d*—a second apparatus substantially the same as the one above described, but at right angles to it, is necessary for grading these patterns.

In this second apparatus the radius-bar is marked *h'*, the cross-bar *j'*, the index-rod *k'*, and the connecting-rod *m'*.

A secondary carriage, *g'*, is mounted upon the carriage *g*, so that it is free to move toward and from the carriage *g*, and the two are connected together not only by the ways upon which the carriage *g'* slides, but also by the radius-bar *h'* and cross-bar *j'*, as shown in the drawings. The secondary carriage *g'* carries the marker *f*.

The operation of the two carriages *g* and *g'*, radius-bar *h'*, cross-bar *j'*, and slide *f'* is the same as before explained in regard to the carriages *b* and *g*, radius-bar *h*, cross-bar *j*, and slide *a'*, except, of course, that when the axis which connects the radius-bar *h'* and slide *f'* coincides with the axis which connects the cross-bar *j'* and carriage *g*, the figure described by the marker is identical with that described by the tracer, (except as changed by the apparatus a^1, *b*, *h*, and *j*;) and to vary these figures in lines parallel with the support *d*, the axis of the radius-bar must be shifted to one side or the other of the axis of the cross-bar, these lines growing shorter in the figure marked out than in that described by the tracer in proportion as the former axis is carried toward the connecting-rod m^1.

This combination of these two apparatuses, each substantially like the one first described, but one working across the other—that is, one altering the figure described by the tracer along one set of parallel lines, and the other altering it along a second set of parallel lines, one set of these lines crossing the other set—constitutes the second part of my invention.

The connecting-rods *m* and m^1 may be made in one piece with the cross-bars *j* and *j'*, and these cross-bars need not be segmental; but it is of great advantage, when the apparatus is intended for grading shoe-patterns, to make these connecting-rods *m* and m^1 separate from the cross-bars, and to make these bars segmental, for the reason that the segmental cross-bars may be readily and accurately centered, or brought in such relation to the radius-bars *h* and *h'* that the slide a^1 may be moved without moving the carriage *g*, and the slide *f'* without moving the carriage *g'*, and it is when in this condition that the connecting-rod *m* should be rigidly secured by its set-screw to the cross-bar *j*, and the connecting-rod m^1 to the cross-bar *j'*.

If the cross-bar *j* be centered when the axis of the tracer is on a line midway of the length of the pattern and parallel with the support *d*, and the tracer *h* then moved to a line parallel with the midway line and a distance equal to one-half the length of the pattern from it, (see Fig. 6,) the carriages *b* and *g* will be separated more or less as the slide-axis of the radius bar *h* is more or less removed from the axis of the cross-bar *j*, and the amount of this separation will be shown on the graduated index-rod *k*. Consequently, if it be desired to make the pattern described by the marker one size smaller than the standard pattern A, (around which the tracer is to be traversed,) the slide a^1 is moved upon the cross-bar *j* just far enough from the axis of the cross-bar to move the marker *f* one-sixth part of an inch farther from the tracer than it was when the tracer-axis was on the midway line; in other words, when centered, the tracer and marker are each upon the midway line, the tracer on the midway line of the standard, and the marker upon the midway line of the figure which it will describe, and when the tracer is brought to the extreme point in its motion away from this line the marker will be brought in the same relation to its midway line, and consequently, if the marker at this extreme be one-sixth of an inch nearer its midway line than the tracer is to its midway line, it is clear that the extreme points passed over by the marker, one each side of its midway line, will be each one-sixth of an inch nearer its midway line than the extreme points passed over by the tracer and its midway line, and the figure described by the marker will therefore be one-third of an inch shorter than that described by the tracer, two shoe-patterns consecutive in size differing ordinarily one-third of an inch in length.

To illustrate from the drawings: When the cross-bar *j* is centered while the tracer-axis is upon the midway line of the standard, the point of the marker is brought, of course, upon the midway line of the figure which will be described by the marker, and when the tracer-axis is brought upon the extreme line *y* of the standard the marker-point is brought upon the corresponding line of the figure it describes. Now set the marker-point one-sixth of an inch nearer its midway line than the tracer is to its midway line by moving slide a^1 on the cross-bar *j*, and then clamp slide a^1 to the cross-bar *j*. After this is done, when the tracer-axis is carried around the standard A, the marker will also be caused to describe a similar figure, but shorter by one-sixth of an inch on each side of the central line, or one-third of an inch in all along its greatest length, and diminishes in length along any line parallel with the support *c*, the amount of diminution having the same proportion to one-third of an inch that the length of the given line bears to the length of the longest line in the standard parallel to the support *c*.

If it were always desirable to center the cross-bars on the midway lines, the connect-

ing-rods m and m^1 might be made in one piece with the cross-bars; but even then it might be desirable to make them separate, in order to allow for readjustment in case of wear. But inasmuch as it is important to provide means for centering the cross-bars not only on the midway line, but also on the extreme lines y or z, the connecting-rods m and m^1 are made separate from the cross-bars j and j', and connected to them by clamps. This is also an important feature of my invention, and enlarges the scope of my apparatus. For example: Center the cross-bar j when the tracer-axis is on the extreme line z, and clamp the slide a^1 at some distance from the axis of the cross-bar; then move the tracer-axis to the other extreme line y, and the index-rod k will show how much the tracer and marker have been separated by this movement, (supposing the slide a^1 to be between the axis of the cross-bar j and its connecting-rod, the two carriages being drawn nearer together, if the slide be the other side of this axis;) then unclamp the slide a^1, and move it upon the cross-bar until the marker-point is brought the desired distance from the point where it was when the cross-bar was centered the greatest length of the desired figure, taking care, of course, (by means of a proper stop, B, or otherwise,) to keep the tracer-axis upon the extreme line y while adjusting the slide a^1. When the slide a^1 is properly adjusted, reclamp it upon its cross-bar. The result, as is clear, will be that the extreme lines on the figure described by the marker will be nearer together than the corresponding extreme lines y and z of the standard, the marker-point always coming upon the line corresponding to z when the tracer-axis is on z, and traveling away from that line a less distance than the tracer travels from the line z of the standard. When centered upon the extreme line, the distance indicated upon the index-rod is of course the whole difference between the longest line of the standard and the corresponding line in the figure described by the marker, instead of half that distance, as when centered upon the midway line.

Figs. 4 and 5 are diagrams, the first representing the tracer-axis upon the intersection of the two extreme lines z and z', (z indicating a line through the extreme left-hand point of the standard A, and z' a line through the extreme lower point of standard A,) and showing both cross-bars j and j' centered, and the second representing the tracer-axis upon the intersection of two other lines, y and y', (y indicating a line through the extreme right-hand point of the standard A, and y' a line parallel with z', and at a distance from it equal to one-half the extreme length of standard A, or one-half of the distance from z to y.) When in this latter position the slides a^1 and f' may both be adjusted to cause the figure described by the marker to vary as desired from the standard.

The methods of adjusting the cross-bar j' and slide f' require no description, in view of what has been said about adjusting the cross-bar j and slide a^1, and, as will be clear, the slide f' may be adjusted upon the cross-bar j' when the tracer-axis is at any point in the line y', (or any other proper adjusting-line,) just as the slide a^1 may be adjusted upon the cross-bar j when the tracer-axis is at any point in the line y, (or any proper adjusting-line,) although it is only when the tracer-axis is at the intersection of both adjusting-lines that both the slides can be adjusted.

The usual adjustment of the slide f' in making shoe-patterns is from the line z' to the line y', or one-half the length of the standard.

The index-rod k' is set accordingly.

I have shown the cross-bar j controlled by a connecting-rod, m, jointed to a radius-bar, n, which radius-bar has its axis on the support d, and this is the preferred form of my machine; but it is obvious that other devices may be used for giving the proper motion to the cross-bar j. For example, it may be connected to a slide, n^1, (see Fig. 2,) which travels upon a rod, n^2, secured to a frame, n^3, which is adjustably held by a set-screw to the support d.

The cross-bar j' is controlled by the connecting-rod m^1, one end of which is secured to the slide m^2, which travels on the rod m^3, this rod m^3 being secured to the bracket m^4. The controlling device may, of course, be applied to the other end of either of the cross-bars j j', the only function of these devices being to give the proper motion to the cross-bar.

In upper-patterns the height and width of the ankle-part are greater in proportion in the small sizes, and a set of properly-graded patterns should have the ankle part decreased slightly less than any other portion as the patterns decrease in size, the largest size having the ankle part lower and narrower, in proportion to the rest of the pattern, than the smallest size.

This may be accomplished in my machine to a greater or less extent, to suit the taste of the pattern-maker, by adjusting the connecting-rod m, or by changing the slant of the rod n^2.

The fact that that motion of the marker which is caused by the motion of the cross-bar j and j' is greater or less (on the well-known principle of the crank) in proportion to the relative positions of these cross-bars and their respective radius-bars also causes this variation in the proportion of the ankle part to the rest of the pattern.

The tracer (shown in detail in Figs. 7, 8, and 9) also constitutes an important feature of my invention. Its distinguishing feature is, that the bearing-surface a^2 is free to move around the axis a^3. This bearing-surface may be a disk journaled on the piece a^4, as in Figs. 8 and 9, or may be rigidly attached to the piece a^4, as in Fig. 7.

What I claim as my invention is—

1. The combination of the tracer and marker

carriages by means of the cross-bar *j* and radius-bar *h*, substantially as described.

2. In combination, the tracer-carriage *b*, marker-carriages *g* and *g'*, cross-bars *j* and *j'*, and radius-bars *h* and *h'*, substantially as described.

3. In combination, the tracer-carriage *b*, marker-carriage *g*, radius-bar *h*, and cross-bar *j*, when the latter is connected to the support *d*, substantially as described.

4. In combination, the carriages *g* and *g'*, radius-bar *h'*, cross-bar *j'*, connecting-rod m^1, and stationary bracket m^4, substantially as described.

5. The tracer above described, consisting of the parts a^2, a^3, and a^4, constructed and operating substantially as described.

6. In combination, the supports *c* and *d*, carriages *b*, *g*, and *g'*, and suitable devices for controlling the motion of the carriages, all substantially as described.

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