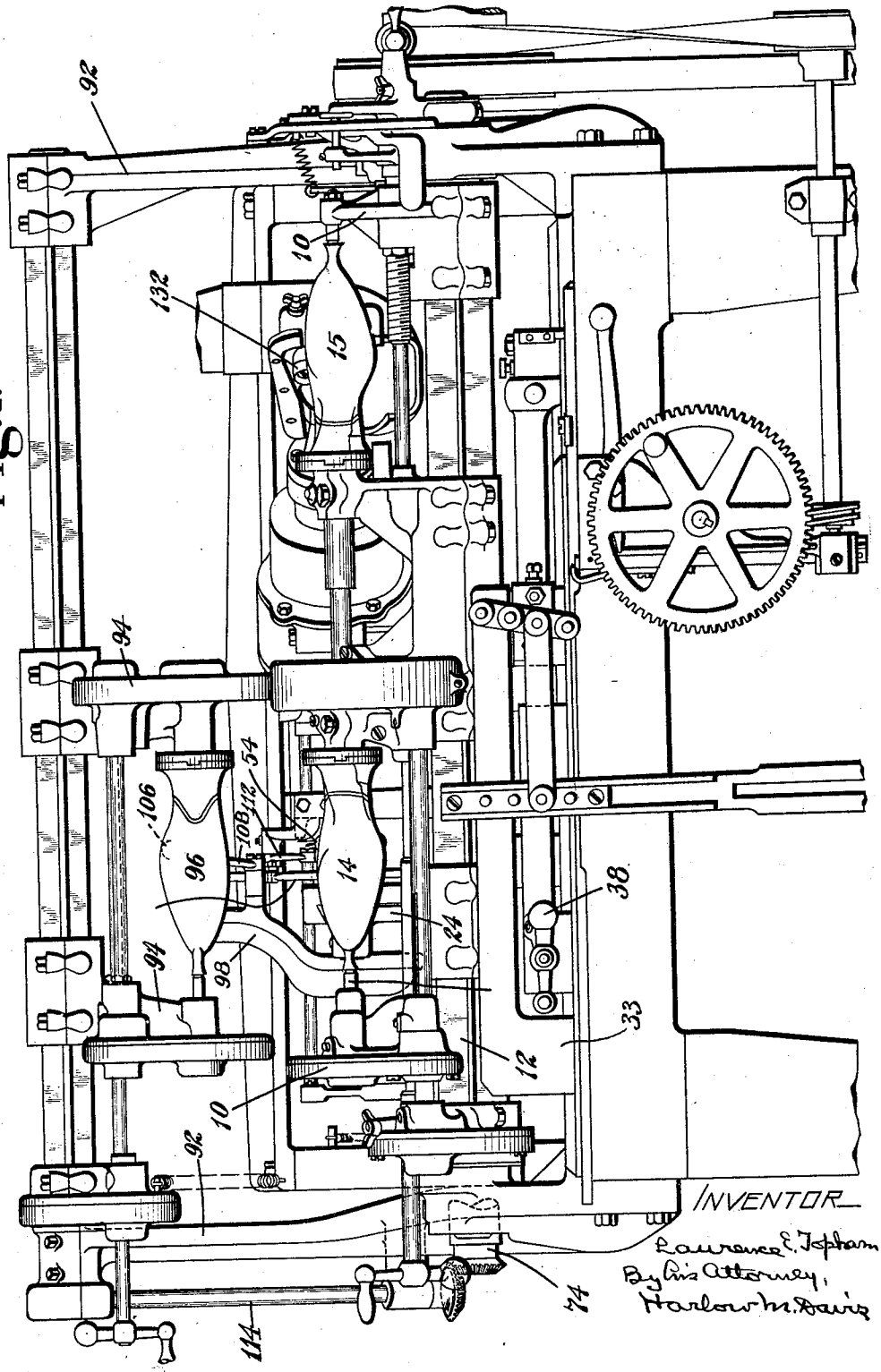
April 8, 1930. L. E. TOPHAM 1,753,391

LAST LATHE

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Fig.1.



INVENTOR
Lawrence E. Topham
By his Attorney,
Harlow M. Davis

April 8, 1930. L. E. TOPHAM 1,753,391

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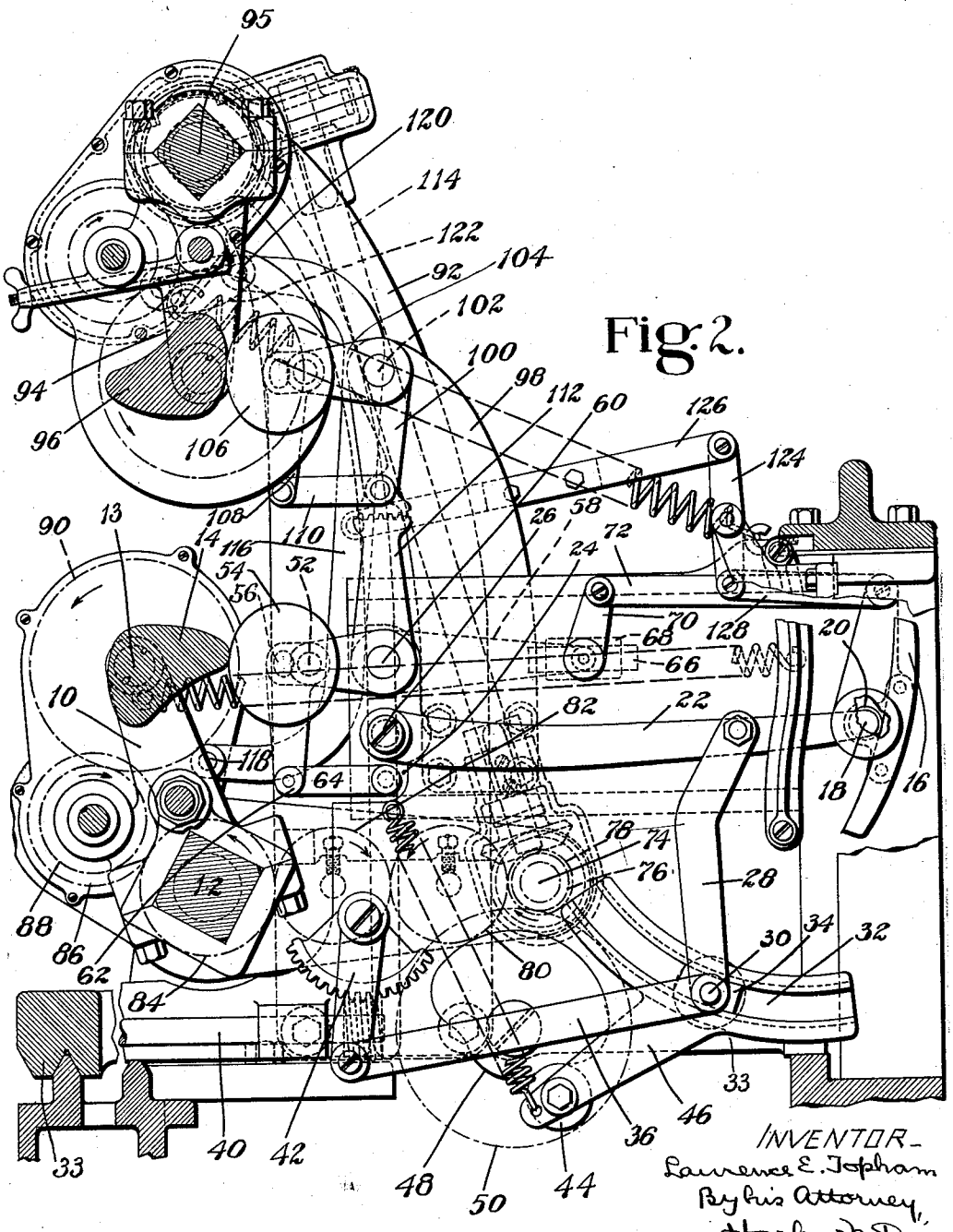


Fig. 2.

INVENTOR-
Lawrence E. Topham
By his Attorney,
Harlow M. Davis

Patented Apr. 8, 1930 1,753,391

UNITED STATES PATENT OFFICE

LAURENCE E. TOPHAM, OF WENHAM, MASSACHUSETTS, ASSIGNOR TO UNITED SHOE MACHINERY CORPORATION, OF PATERSON, NEW JERSEY, A CORPORATION OF NEW JERSEY

LAST LATHE

Application filed August 15, 1928. Serial No. 299,690.

This invention relates to copying irregular objects, and is illustrated, in its machine aspect, as embodied in a last lathe generally of the type shown in my applications Serial No. 429,719, filed Dec. 10, 1920, now Patent #1,716,672; Serial No. 530,214, filed Jan. 18, 1922, now Patent #1,713,792; and Serial No. 284,078, filed June 9, 1928, now Patent #1,724,981.

In these applications, I have shown a width grading mechanism which can be made to operate with a variable magnification factor, and in particular with a factor which varies in any predetermined cycle, in time with the rotation of the model and last block. A practical problem discussed in my prior applications mentioned was that of last width grading from a model in such a way that the bottom face of the model is reproduced exactly in the last block, all the width grading being done above the bottom.

The width grading mechanism as heretofore constructed in copying lathes has always multiplied the model radius, measured from the axis of rotation to the surface point then in contact with the model wheel, by the grading factor then being utilized, or in ordinary language, the machine "grades from the radius". The present invention contemplates grading "from the diameter", as measured perpendicularly through the model axis from the surface point in contact with the model wheel, to the other side, with the advantage that when anomalous grading is being done in one part of the rotation cycle, as when the bottom of the model is being held unchanged, the entire diameter of the last is available for magnification in the opposite part of the rotation cycle, as on the upper side of the model, instead of merely the upper radius alone. The diameters of lasts, in their foot-fitting portions, vary less extremely than their radii, and thus in grading from the diameter a magnification factor cycle can be found which will be better adapted to the entire foot-fitting portion of the last than in the case where the grading is done from the radius alone, since some radii of a last, for example, at the upper surface of the ball portion, are often small, and a magnification factor which will adequately magnify the entire cross-section at such points without the help of the larger radii running to the bottom may be ill adapted to the other parts of the last where the radii to the upper surface are much longer.

The invention, therefore, comprises, in its method aspect, the magnification or grading of models by, in effect, increasing their diameters (instead of their radii) and adding algebraically, in the work, a part of the diameter instead of a part of the radius, in building up the surface of the work.

In the operation of the machine illustrated as embodying the invention in its machine aspect and by the aid of which the method of the invention may be practised, the two radii forming a diameter are simultaneously measured, and the effect due to each is transmitted into the grading mechanism. The construction is such that half of the magnification due to both of the radii comprising a diameter is applied at each end of the corresponding diameter in the work, so that the total diametral magnification is the same as in grading from the radius, but half of it is applied at each end of the diameter, instead of that part of the magnification due to each radius being applied at the end of that radius. Thus the accretion at the end of a small radius, with a given magnification factor, can be larger than under the former practice, and if the oppositely extending radius is not to be magnified, it is not necessary to use such an extreme magnification factor on the short radius. In the illustrated machine the ends of the two opposed radii contact with two model wheels respectively, and these contacts control a grading slide.

These and other features and aspects of the invention will be better understood from the following description of a preferred embodiment of the machine aspect of the invention, by means of which the method can be practised.

In the drawings,

Fig. 1 is a front elevation of a last lathe embodying the invention in a preferred form; and

Fig. 2 is an enlarged sectional side eleva-

tion of the swing frames and model wheel carriage of the machine shown in Fig. 1.

In the illustrated last lathe, the swing frame 10 is similar in construction to that shown in my application Serial No. 530,214, filed Jan. 18, 1922, to which reference may be made for details not herein described. The center of rotation is the axis of the heavy shaft 12.

The width grading fanboard 16 is pivoted at 18 on the machine frame. It contacts with a feeler roll 20 on the end of a feeler link 22 pivoted to the model wheel or grading slide 24 at 26. The link 22 is shown in neutral position, under which condition a link 28, pivoted to it, will just reach to the pivotal center 30 of a slotted segment 32 mounted on the model wheel carriage 33. A block 34, to which the link 28 is pivotally connected, is adjustable in the slot in the segment 32 by a link 36 which is adjustable by a handle 38 on a shaft 40 having a worm and screw connection with a crank arm 42 pivoted to the link 36. Proper adjustment of the block 34 will therefore adjust the roll 20 on the fanboard 16. The segment 32 can be moved about its pivotal center 30 by a roll 44 on an arm 46 attached to the segment, actuated by a cam 48 on a gear 50, which is rotated at the same speed as the model and block. The movement of the segment thus imparts a cyclic movement to the roll 20, when the block 34 is set off the center 30, and thereby automatically effects a cyclic variation of the position of the roll 20 and consequently of the width grading factor, the length of the cycle corresponding to the rotation time of the model and work. This width grading mechanism will be found more fully explained in my application Serial No. 429,719, filed Dec. 10, 1920. Obviously the cam 48 can be designed to return the roll 20 to its neutral position in line with the pivot 18 when the bottom of the model is in contact with the model wheel, thus reproducing the bottom exactly; and to effect all the magnification required above the bottom.

The model wheel suspension and the mechanism for keeping the model wheel center in the grading plane (the plane passing through the axis of rotation 13 and the neutral position of the center 52 of the model wheel 54) is substantially like that shown in my application Serial No. 530,214. The model wheel 54 is pivoted on an extension 56 making an angle of about 30° with a stub shaft indicated also by the reference numeral 52, Fig. 2, on which the extension is mounted. The model wheel center 52 lies at the intersection of the axis of the stub shaft and the extension. The stub shaft is mounted in the end of a lever 58 pivoted at 60 on the model wheel slide 24, and has a crank arm 62 connected by a link 64 with the model wheel slide. The structure 60, 58, 56, 62, 64 forms a parallelogram. This arrangement keeps the extension on the stub shaft from rotating in space as the lever 58 turns, carrying the model wheel with it, so that the axis of the model wheel always remains parallel to itself and consequently in the same angular relation to the grading plane (passing through the model and work axes and the cutter center) and the correspondingly oriented cutter axis. This relation is necessary in order to preserve similarity of conditions on the model and work sides of the machine.

The rear arm of the lever 58 carries a pivoted slide block 66 working in a slideway 68 fastened to a crank arm 70 mounted on the model wheel carriage 33, and connected to the fanboard 16 by a link 72. As explained in my application Serial No. 530,214, this structure will cause the model wheel center 52 to remain always in the grading plane, following the axis 13 as the swing frame 10 oscillates, and thus to preserve the similarity of conditions above referred to.

The model 14 is driven by a chain of gearing beginning at a shaft 74 having a long pinion 76 on it which drives the gear 50, as this gear is carried along by the model wheel carriage 33. A gear 78 on the shaft 74 drives a train of gears 80, 82, 84 the last being concentric with the shaft 12. The gear 84 drives integral gears 86 and 88, mounted on the swing frame 10, and the gear 88 drives a gear 90, having just twice as many teeth and mounted on the model axis 13. It is shown in my application Serial No. 530,214 that this structure will keep any radial plane of the model in the grading plane irrespective of swing frame rotation, and thus preserve the proper reverse relation between the model and work sides of the machine when the model and work are rotated in opposite directions in so-called reverse cutting.

All of the structure so far described is substantially identical with structure described in my applications Serial No. 530,214 and Serial No. 429,719, to which reference may be made for details not here mentioned.

At each end of the machine are mounted a pair of standards 92, at the upper ends of which is mounted a downwardly hanging swing frame 94 similar in all other respects to the swing frame 10, and arranged to carry a second model 96. As shown, this model is mounted in a position rotated 180° from the position of the model 14. A standard 98 mounted on the model wheel slide 24 carries a bell crank having two arms 100, 104 with its pivot 102 directly above the pivot 60. The horizontal arm 104 of the crank carries a model wheel 106 which is mounted on it in just the same way as the model wheel 54 on the front end of the lever 58. The crank arm 108 corresponds to the crank arm 62, and the link 110, connecting the arm 108 to the standard 98, corresponds to the link 64.

The crank arm 100 is geared to an equal crank arm 112 mounted at 60 on the lever 58. Thus, the two model wheel suspensions are identical. The model 96 is driven by gearing exactly like that described for the model 14, the rotation being in the same direction and at the same speed, by virtue of a shaft 114 and appropriate gearing connecting the upper gearing to the shaft 74.

The two swing frames are connected to the fanboard 16 as follows. The swing frames are connected to each other by a link 116 pivoted to the lower frame at 118, and pivoted at 120 to one end of a short link 122 pivoted at its other end to the upper frame, thus permitting the frames to swing freely. The center of the link 116 is linked to the upper end of a rock-lever 124 by a link 126 and the lower end of the rocklever is linked to the fanboard by a link 128. Thus the movement of the link 128 and consequently of the fanboard is the average of the movements of the two swing frames which are easily seen to be proportional respectively to the two radii in contact with the two model wheels. Owing to the 180° difference in the positions of the models these two radii, taken together, form the same diameter of the models 14, 96. Thus, the accretion at any point of the block is equal to the accretion factor multiplied by half the corresponding diameter of the model, instead of the radius to the point in question, or by the mean of the two corresponding radii forming this diameter of the model. By the accretion factor is meant the grading or magnification factor minus unity, taken algebraically. That is, if the block is 10% larger than the model, the grading factor is 1.10 and the accretion factor is $1.10-1.00=0.10$; and if the block is 10% smaller than the model, the grading factor is 0.90 and the accretion factor is $0.90-1.00=-0.10$.

Therefore, the grading action at any point is based on the length of the diameter extending to that point, instead of merely the radius extending to that point, so that if the bottom radii for example are to be reproduced unchanged they still have an effect in the grading of the upper part of the model, and it is therefore unnecessary to adopt such an extreme grading factor for the top as would be necessary if only the upper radii were available there for magnification.

The contact of the two model wheels 54, 106 with geometrically opposite sides of the identical models 14, 96 amounts in effect to calipering the corresponding diameter or measuring the two corresponding opposed radii of either one of the models, and this diameter is multiplied by one-half the grading factor then being utilized in the machine. The two models may be said to be engaged by the model wheels on opposite sides of their (identical) model figure, by which is meant opposite sides of the models considered as recognizable geometrical shapes, irrespective of their positions in space. Each model wheel remains in its own grading plane by virtue of the connection 100—112, and any diametral plane of each model which is in its grading plane remains in its grading plane irrespective of its swing-frame rotation, by virtue of the drive gearing described.

The gear 50, as stated, is rotated at the same angular velocity as the models, and by proper design of the cam 48 any desired cycle of setting of the feeler roll 20 on the fanboard 16 can be obtained, as described in my application Serial No. 530,214.

The mounting of the block 15, the construction of the cutter 132 and the drive of the model wheel and cutter carriages are all as described in my application Serial No. 530,214.

Having described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. In a pattern copying machine, means for holding a block and a model, a tool, and a width grading mechanism arranged to co-operate with the model, the width grading mechanism being constructed and arranged to grade from a diameter of the model instead of from a radius comprised in the diameter.

2. In a pattern copying machine, means for holding a block and a model, a tool, and a width grading mechanism arranged to co-operate with the model, the width grading mechanism being constructed and arranged to caliper the diameter of the model and to multiply it by a magnification factor in the block.

3. In a pattern copying machine, means for holding a block and a model, a tool, and a width grading mechanism arranged to co-operate with the model, the width grading mechanism being constructed and arranged to measure two oppositely extending radii of the model and to magnify their sum in the work.

4. In a pattern copying machine, means for holding a block and a model, a tool, and a width grading mechanism arranged to co-operate with the model, the width grading mechanism being constructed and arranged to measure two oppositely extending radii of the model and to multiply their mean by the width grading factor.

5. In a pattern copying machine, means for holding a block and a model, a tool, and a width grading mechanism arranged to co-operate with the model, the width grading mechanism being constructed and arranged to measure two oppositely extending radii of the model and to add algebraically to the block radius then on the cutter a quantity depending upon the mean of the two said oppositely extending model radii.

6. In a pattern copying machine, means for holding a block and a model, a tool, and a width grading mechanism arranged to co-op-

erate with the model, the width grading mechanism being constructed and arranged to measure two oppositely extending radii of the model and to add algebraically to the block radius then on the cutter a quantity depending upon the sum of the two said oppositely extending model radii.

7. In a pattern copying machine, means for holding a block and a model, a tool, and a width grading mechanism arranged to co-operate with the model, the width grading mechanism being constructed and arranged to measure two oppositely extending radii of the model and to add algebraically to each of the corresponding block radii a quantity equal to the product of the mean of the said model radii by the accretion factor.

8. In a pattern copying machine, means for holding a block and a model, a tool, and a width grading mechanism arranged to co-operate with the model, the width grading mechanism being constructed and arranged to measure two oppositely extending radii of the model and to add algebraically, at laterally opposite points of the block, to the model radius being graded, a quantity equal to the product of the mean of the model radius being graded and its opposed radius by the accretion factor.

9. A width grading mechanism for a copying lathe comprising a grading slide and two model wheels, and means for moving the slide controlled by the contact of the model wheels with two opposed model radii.

10. A width grading mechanism for a copying lathe comprising a model holding means, a grading slide carrying two model wheels arranged for movement toward and from the model holding means, and means for moving the slide controlled by contact of the model wheels with the ends of opposed model radii.

11. A copying lathe having two oscillating frames, model holding means in each frame, two model wheels arranged to contact with opposite sides of the model figure of the models in the model holding means, respectively, and a grading slide governed by the oscillating frames.

12. A copying lathe having two oscillating frames, model holding means in each frame, two model wheels arranged to contact with opposite sides of the model figure of the models in the model holding means, respectively, a grading slide, a control therefor, and a connection between each oscillating frame and the grading slide control.

13. A copying lathe having two oscillating frames, model holding means in each frame, two model wheels arranged to contact with geometrically opposite sides of models in the model holding means, respectively, a grading slide, a link connecting the oscillating frames, and a connection between the grading slide and a mid point of the link.

14. A copying lathe having two oscillating frames, model holding means in each frame, two model wheels arranged to contact with models in the model holding means on opposite sides, respectively, of the model figure defined by said models, a grading slide, a link connecting the oscillating frames, and a connection between the grading slide and the link.

15. A copying lathe having two oscillating frames, model holding means in each frame, two model wheels arranged to contact with models in the model holding means on opposite sides, respectively, of the model figure defined by said models, a grading slide, a fanboard to operate the grading slide, and a connection running from the fanboard to both oscillating frames.

16. A copying lathe having two oscillating frames, model holding means in each frame, two model wheels arranged to contact with geometrically opposite sides of models in the model holding means, respectively, a link connecting the oscillating frames, a grading slide, a fanboard to operate the grading slide, and a connection running from the fanboard to the link.

17. A copying lathe having two oscillating frames, model holding means in each frame, two model wheels arranged to contact with models in the model holding means, substantially respectively, on opposite ends of corresponding diameters thereof, a link connecting the oscillating frames, a grading slide, a fanboard to operate the grading slide, and a connection running from the fanboard to the center of the link.

18. A copying lathe having two oscillating frames, model holding means in each frame, two model wheels arranged to contact with models in the model holding means, substantially respectively, on opposite ends of corresponding diameters thereof, a grading slide, a fanboard, an adjustable feeler extending from the grading slide to the fanboard, a connection between the fanboard and both oscillating frames, and means for automatically altering the adjustment of the feeler during the production of a work piece.

19. A copying lathe having two oscillating frames, model holding means in each frame, two model wheels arranged to contact with models in the model holding means, substantially respectively, on opposite ends of corresponding diameters thereof, a grading slide, a fanboard, an adjustable feeler extending from the grading slide to the fanboard, a connection between the fanboard and both oscillating frames, and means for automatically altering the adjustment of the feeler during the production of a work piece, said last-mentioned means operating in a cycle having the same time length as a rotation of a model.

20. In a pattern copying machine, means for holding a block and a model, a tool, a

width grading mechanism arranged to co-operate with the model, the width grading mechanism being constructed and arranged to grade from a diameter of the model instead of from a radius thereof, and means for automatically altering the grading factor during the production of a work piece.

21. That improvement in methods of pattern copying which consists in width grading from a diameter of the model instead of from a radius comprised in the diameter.

22. That improvement in methods of pattern copying which consists in measuring a diameter of the model instead of a radius comprised in the diameter and determining a point in the surface of the work by adding to the corresponding model radius the product of half the corresponding model diameter by the accretion factor.

23. That improvement in methods of pattern copying which consists in measuring two opposed model radii and determining a point on the surface of the work corresponding to the end of one of the said model radii by adding to the said corresponding model radius the product of the mean of the two said model radii by the accretion factor.

24. That improvement in methods of pattern copying which consists in measuring two opposed model radii and determining two opposed points on the surface of the work corresponding to the ends of the said model radii by adding to each of the said corresponding radii half the product of the sum of the said model radii by the accretion factor.

In testimony whereof I have signed my name to this specification.

LAURENCE E. TOPHAM.