



(No Model.)

3 Sheets—Sheet 2.

C. W. MACCORD.  
LATHE FOR TURNING ELLIPTICAL FORMS.

No. 531,203.

Patented Dec. 18, 1894.

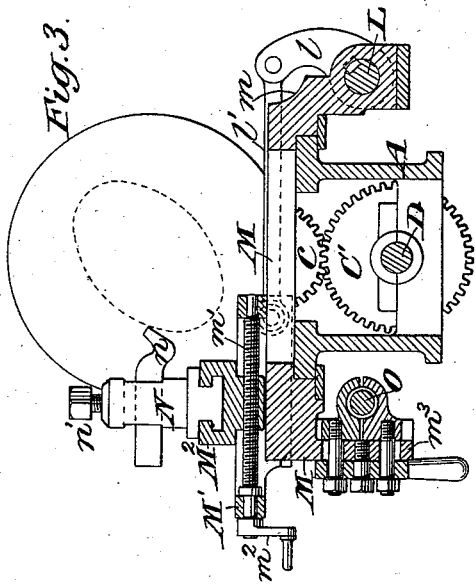


Fig. 3.

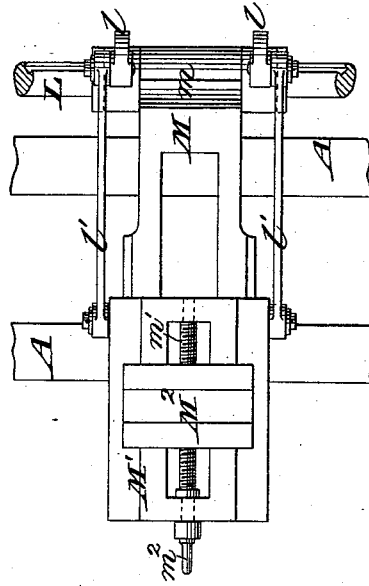


Fig. 4.

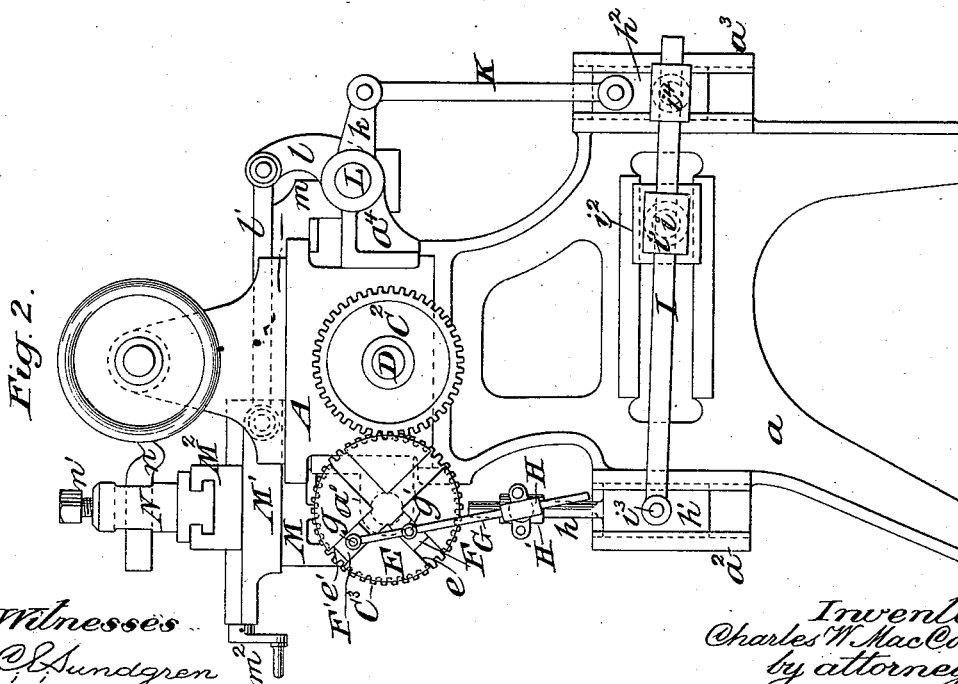


Fig. 2.

Witnesses  
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*George Barry*

Inventor:  
*Charles W. MacCord*  
 by attorneys  
*Brown & Sewall*

(No Model.)

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Fig. 8.

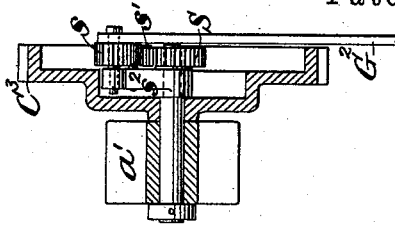


Fig. 7.

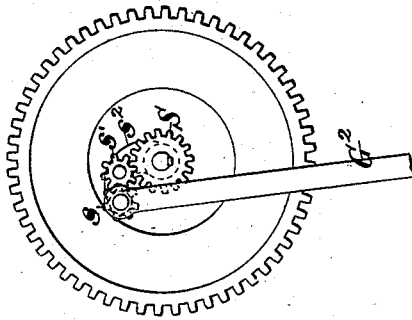


Fig. 6.

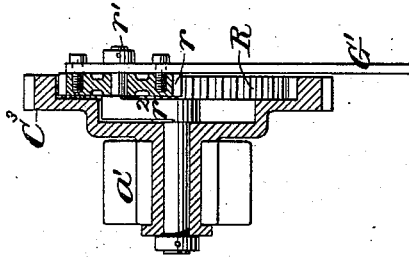
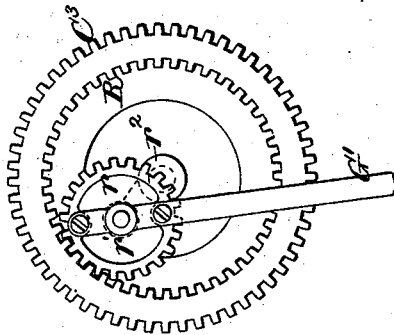


Fig. 5.



Witnesses:

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# UNITED STATES PATENT OFFICE.

CHARLES W. MACCORD, OF HOBOKEN, NEW JERSEY, ASSIGNOR TO THE PRATT & WHITNEY COMPANY, OF HARTFORD, CONNECTICUT.

## LATHE FOR TURNING ELLIPTICAL FORMS.

SPECIFICATION forming part of Letters Patent No. 531,203, dated December 18, 1894.

Application filed March 29, 1894. Serial No. 505,544. (No model.)

To all whom it may concern:

Be it known that I, CHARLES W. MACCORD, of Hoboken, in the county of Hudson and State of New Jersey, have invented a new and useful Improvement in Lathes for Turning Elliptical Forms, of which the following is a specification.

My invention relates to an improvement in lathes for turning elliptical forms, in which provision is made for setting the parts at pleasure to turn ellipses having any given ratio, within the compass of the machine, between their major and minor axes.

A practical embodiment of my invention is represented in the accompanying drawings, in which—

Figure 1 represents a view of a lathe embodying my invention, in side elevation. Fig. 2 is a view of the foot end of the lathe, in elevation. Fig. 3 is a transverse section through the bed and sliding rest, looking toward the head stock. Fig. 4 is a top plan view of the slide rest, its carriage and their operating mechanism, the tool post being removed. Figs. 5 and 6 represent, respectively, in face elevation and transverse section, a modified form of elliptographic trammel; and Figs. 7 and 8 represent similar views of still another form of the elliptographic trammel.

A represents the bed of the lathe, shown in the present instance as supported upon legs or pedestals *a*.

B represents the head stock of the lathe in which is mounted the mandrel *b*, provided with the usual band pulleys and having fixed thereon a toothed wheel C in gear with an idle wheel *c*, the latter in gear with a wheel C', equal to the wheel C, the wheel C' being fixed to rotate with a shaft D extending along the bed of the lathe and provided at the foot end of the lathe with a toothed wheel C<sup>2</sup>, equal to the wheel C', and geared with an equal toothed wheel C<sup>3</sup>, mounted to rotate freely in suitable bearings in a bracket *a'*, fixed to the bed A.

A disk E is fixed to rotate with the wheel C<sup>3</sup>, being in the present instance applied to the face of the wheel C<sup>3</sup>, the disk E being provided in its face with grooves *e* and *e'* ex-

tending diametrically across the face of the disk at right angles to each other. In the grooves *e* and *e'* blocks F and F' are arranged to slide, the former in the groove *e* and the latter in the groove *e'*. The blocks F and F' are pivoted to a bar G at points *g*, *g'* and the bar G is provided with a socket piece H which may be adjusted at different distances from the end of the bar by any well known or approved means. The socket piece H is pivoted to a second socket piece H' which latter is provided with any well known or approved means for holding it in different adjustments along the rod or bar *h*, fixed to a vertically sliding piece *h'* held in a suitable groove formed in a projection *a<sup>2</sup>* either fixed to or formed integral with a pedestal of the lathe.

A vibrating lever I is fulcrumed at *i* in a socket piece *i'* pivotally secured to a horizontally sliding block *i<sup>2</sup>* held in a suitable groove formed therein in the pedestal of the lathe. One end of the lever I is pivotally secured at *i<sup>3</sup>* to the sliding piece *h'* and the opposite end is secured in a socket piece *i<sup>4</sup>*, pivoted to a vertically sliding piece *h<sup>2</sup>* held in a suitable groove formed therefor in a projection *a<sup>3</sup>*, fixed to or formed integral with the pedestal of the lathe. Any well known or approved means may be employed for locking the horizontally sliding block *i<sup>2</sup>* in its adjusted position along its horizontal groove.

The vertically sliding piece *h<sup>2</sup>* is connected by a rod K with an arm *k* fixed on a rock shaft L, extending longitudinally along the lathe and mounted in suitable bearings in brackets *a<sup>4</sup>* attached to the lathe bed. The rock shaft L extends through a downward projection *m* on the bed M of the sliding rest, so that the slide rest is permitted to move freely along the bed of the lathe without hindrance from the shaft L. The bed M of the slide rest is surmounted by a carriage M' mounted on the slide transversely across the lathe bed and said carriage M' is connected by a pair of rods *l'* with a pair of arms *l* mounted on the rock shaft L so as to rock with the rocking of the shaft and at the same time be free to slide longitudinally along

the shaft L with the slide rest. The connection of the arms  $l$  with the rock shaft L may be of the ordinary feather and groove type. The working length of the arms  $l$  is equal to the working length of the arm  $k$  and the centers of their connections with the rods  $l'$  and K are in planes at right angles to each other at the axis of the rock shaft L. The working lengths of the connecting rods  $l'$  and K are also made equal to each other.

The transversely sliding carriage  $M'$  is surmounted by another carriage  $M^2$ , arranged to slide transversely of the lathe bed and operated by a screw  $m'$  mounted in the carriage  $M'$  and provided with an operating crank  $m^2$ . The tool post N is secured in the carriage  $M^2$ , in the present instance in such a manner that it may be adjusted to a limited extent lengthwise of the lathe bed and the cutting tool  $n$  is held in the post by a set screw  $n'$ . The sliderest M is further provided with a depending attachment  $m^3$  for engaging it with a feed screw O in the usual manner.

The disk E with its grooves  $e$  and  $e'$ , sliding blocks F and F', bar G and the guide for keeping the movement of the connection H of the bar G in a right line is an application of one form of the well known elliptographic trammel and the length of the movement of the connection H in a right line will be equal to the distance between the points  $g$  and  $g'$  where the bar G is connected with the sliding blocks and will also be equal to the difference between the semi axes of the ellipses, described by a point or marker held at H, and operating upon the face of a disk centered with and moving at the same rate as the disk E.

By means of the connections which have hereinbefore been described, it follows that the disk E is driven at the same rate of speed that the mandrel  $b$  is driven so that, if the tool be made to move toward and away from the piece of work centered in the axis of the mandrel  $b$  and the motion of the tool be made to depend upon the motion of the connection H, under the impulse of the sliding blocks, operated by the rotary movement of the disk E, the point of the tool so held and moved will describe an ellipse and hence will serve to turn the piece of work to an elliptical form in cross section.

If the lever I be fulcrumed at its center, the difference between the semi-axes of the ellipse will be equal to the difference between the pivotal connections  $g$  and  $g'$  of the bar G, with the sliding blocks. The difference between the semi-axes of the elliptical form to be turned may, however, be made to vary to suit the desired form by moving the fulcrum of the lever I either toward or away from the vertically sliding piece  $h'$  so as to increase or decrease the movement of the sliding piece  $h^3$  under a given movement of the piece  $h'$  and in general the adjustments may be effected as follows:

Let  $p$  represent the semi-major axis of any required elliptical form and let  $q$  represent the semi-minor axis of said elliptical form. Then by moving the disk E until the point  $g$  is in its lowermost position, the position of the major axis of the piece of work in the lathe will be horizontal and the bar G will be vertical. Now, loosen the socket pieces H and H' from their bars or rods G  $h$  and move them up or down until the distance H  $g$  bears the same ratio to H  $g'$  as  $p$  bears to  $q$ . The clamp screws being then advanced the adjustment of eccentricity is complete. The vertical traverse of the piece  $h'$  is, however, always equal to the distance between  $g$  and  $g'$ ; whereas the horizontal traverse of the tool must be equal to  $p-q$ . Therefore the block  $i^2$  must be moved until the horizontal distance between the slides  $h'$  and  $h^3$  is divided in such a proportion that the distance between  $i^3$  and  $i$  bears the same ratio to the distance between  $i$  and  $i^2$  that the distance between  $g$  and  $g'$  bears to  $p-q$ . This completes the adjustment for dimensions. The carriage  $M'$  being now at the extreme left of its stroke, it remains to set the point of the tool at a distance  $p$  from the axis of the lathe. This is done by means of a hand operated screw  $m'$  operating upon the carriage  $M^2$ . It is advisable to have a stop of any well known or approved form, not shown herein, which may be adjusted in position to prevent the carriage  $M^2$  from being fed any farther toward the axis of the piece of work than that point where the point of the tool is a distance  $p$  from the axis of the lathe. The carriage may, however, be moved farther away for taking the roughening cuts. While taking those, the piece of work would be turned to a symmetrical but not to a truly elliptical section. This will be gradually approached as the tool is fed in by the hand operated screw  $m'$  and the exact form will be attained when the carriage  $M^2$  is arrested by the stop at the point hereinabove named. After the tool reaches this point, the turning of the piece of work may be completed by the automatic movement of the carriage  $M'$ , under the control of the disk E through intermediate connections.

By the above means, the work to be operated upon may be centered and driven as in a common lathe, its only motion being that of rotation on its axis of symmetry, the elliptic form being produced by an automatic transverse reciprocating motion of the cutting tool, thereby doing away with the objections which pertain to the mounting of the work away from center, and the consequent bodily movement of it through space with respect to the axial line of rotation of its driving mechanism.

I find it desirable to so mount the idle wheel c that it may be thrown out of gear at pleasure in any well known or approved manner as by this simple expedient the elliptical de-

6 vices become inoperative and the lathe may be used like any other for ordinary circular work.

7 Instead of making the fulcrum of the lever  
 8 I adjustable with respect to the lever, it might  
 9 be made stationary and the connections of  
 10 the bar G with the sliding blocks and socket  
 11 piece H be made adjustable after the manner  
 12 of the common elliptographic trammel bar  
 13 and both eccentricity and dimensions may be  
 14 thereby secured. It is also obvious that the  
 15 disk E and its driving wheel C<sup>3</sup> might be lo-  
 16 cated in other positions than those specifi-  
 17 cally shown with respect to the working parts  
 18 of the lathe, such changes being considered by  
 19 me mere modifications of practical detail with-  
 20 out involving any change in the fundamen-  
 21 tal principle of the mechanism previously de-  
 22 scribed.

23 Instead of using the disk and sliding blocks  
 24 to produce the required motion, I may use  
 25 the form shown in Figs. 5 and 6. In this  
 26 form a rolling pinion *r* is geared with an in-  
 27 ternal annular gear R, the latter having  
 28 twice the number of teeth that the pinion has.  
 29 In the present instance the pinion has twenty-  
 30 two teeth and the internal gear forty-four.  
 31 The trammel bar G' is fixed to the side of the  
 32 pinion which in this case, in order to keep it  
 33 in gear with the wheel, is mounted upon the  
 34 pin *r'* of the crank *r*<sup>2</sup> having its axis of rota-  
 35 tion in alignment with the axis of rotation of  
 36 the gear R.

37 Figs. 7 and 8 represent another form of el-  
 38 liptographic trammel. As in Figs. 5 and 6, the  
 39 trammel bar G<sup>2</sup> is connected with a pinion *s*  
 40 operated by a wheel S of twice the number  
 41 of teeth, gearing with an intermediate idle  
 42 wheel *s'*. The essential difference between  
 43 this form and that shown in Figs. 5 and 6 is in  
 44 the location of the pinion with respect to the  
 45 wheel which operates it; Figs. 5 and 6 show-  
 46 ing an internal engagement while Figs. 7 and  
 47 8 show an external engagement. In the  
 48 latter form, the pinions *s* and *s'* are mounted  
 49 loosely upon pins fixed in the arm *s*<sup>2</sup> which  
 50 turns freely upon the shaft to which the wheel  
 51 S is keyed. In both of these cases the tram-  
 52 mel bar will move essentially in the same  
 53 manner as in the form first described, not-  
 54 withstanding their dissimilarity in appear-  
 55 ance, and are held by me to be mechanical  
 56 equivalents for the purposes of operating the  
 57 trammel bar to impart to the cutting tool the  
 58 necessary movements.

59 In view of the various means for imparting  
 60 the necessary rectilinear motion for operat-  
 61 ing the cutting tool to trace an ellipse, I wish  
 62 to be understood as not confining myself, in

63 my present invention, to any special mechan- 60  
 64 ism for such purpose.

What I claim is—

1. In combination, a lathe in which the cut- 65  
 66 ting tool is supported to move toward and  
 67 away from the piece to be operated upon, an  
 68 elliptographic trammel, connections for turn-  
 69 ing the wheel or disk of the trammel at the  
 70 same speed with the lathe mandrel, means for  
 71 converting the movement of one point of the  
 72 trammel bar into a reciprocating rectilinear 70  
 73 movement and connections for transmitting  
 74 the said reciprocating rectilinear motion to  
 75 the cutting tool of the lathe, substantially as  
 76 set forth.

2. In combination, a lathe in which the cut- 75  
 76 ting tool is supported to move toward and  
 77 away from the work, an elliptographic tram-  
 78 mel, connections for driving the wheel or disk  
 79 of the trammel at the same speed with the  
 80 lathe mandrel, means for causing one point  
 81 of the trammel bar to move in a reciprocating  
 82 rectilinear path, connections for imparting  
 83 said reciprocating rectilinear movement to  
 84 the cutting tool, and adjusting devices for in-  
 85 creasing or diminishing the lengths of the  
 86 movements of the tool relatively to the length  
 87 of movement of the rectilinear moving point  
 88 on the trammel bar, substantially as set forth.

3. The combination with the work holding 90  
 91 mechanism of a turning lathe, and a slide ar-  
 92 ranged to move along the lathe bed, of a trans-  
 93 versely movable carriage supported upon the  
 94 slide rest, a second transversely movable car-  
 95 riage surmounting the first named carriage,  
 96 a tool holder carried by said second carriage,  
 97 means for adjusting the tool carrying carriage  
 98 relatively to the first named carriage, an ellip-  
 99 tographical trammel actuated by the lathe  
 100 mandrel and connections between the tram-  
 101 mel bar and the first named carriage for im-  
 102 parting to it its transverse movement, sub-  
 103 stantially as set forth.

4. The combination with a lathe provided 105  
 106 with a transversely movable tool-operating  
 107 carriage, of an elliptographic trammel, a slide  
 108 connected with the trammel bar and arranged  
 109 to move in a right line, a second slide con-  
 110 nected with the said transversely movable  
 111 carriage and arranged to move in a right line,  
 112 a lever connecting the two slides and pro-  
 113 vided with an adjustable fulcrum, and means  
 114 for operating the elliptographic trammel, sub-  
 115 stantially as set forth.

CHARLES W. MACCORD.

Witnesses:

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