No. 743,293. PATENTED NOV. 3, 1903.

M. E. KNIGHT & J. M. BENJAMIN.

AUTOMATIC TOOL FOR BORING OR PLANING CONCAVE OR CYLINDROIDAL SURFACES.

NO MODEL. APPLICATION FILED NOV. 6, 1902. 4 SHEETS—SHEET 1.

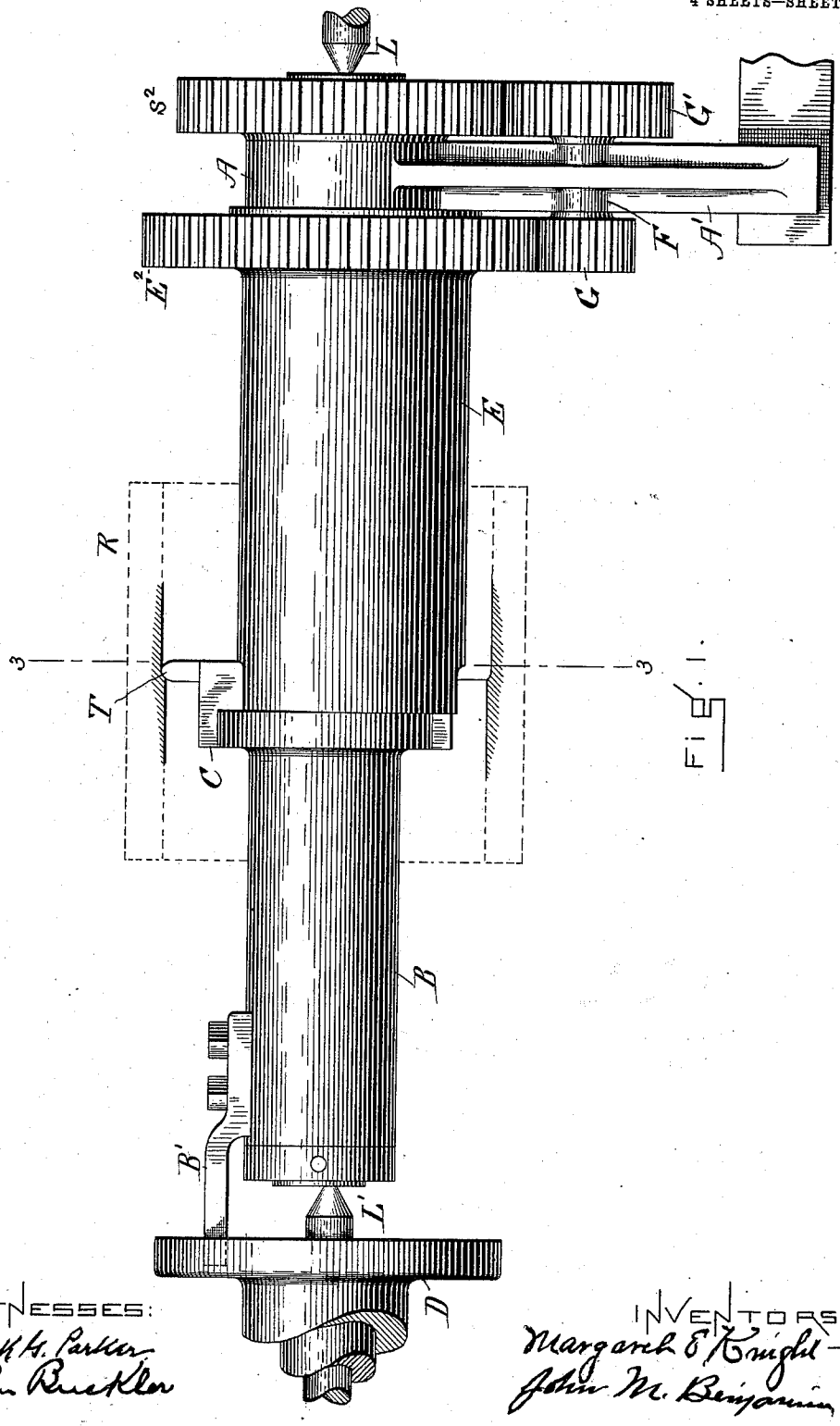


Fig. 1.

WITNESSES:
Frank H. Parker
John Buckler

INVENTORS:
Margaret E. Knight
John M. Benjamin

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 743,293. PATENTED NOV. 3, 1903.

M. E. KNIGHT & J. M. BENJAMIN.

AUTOMATIC TOOL FOR BORING OR PLANING CONCAVE OR CYLINDROIDAL SURFACES.

APPLICATION FILED NOV. 6, 1902.

NO MODEL. 4 SHEETS—SHEET 2.

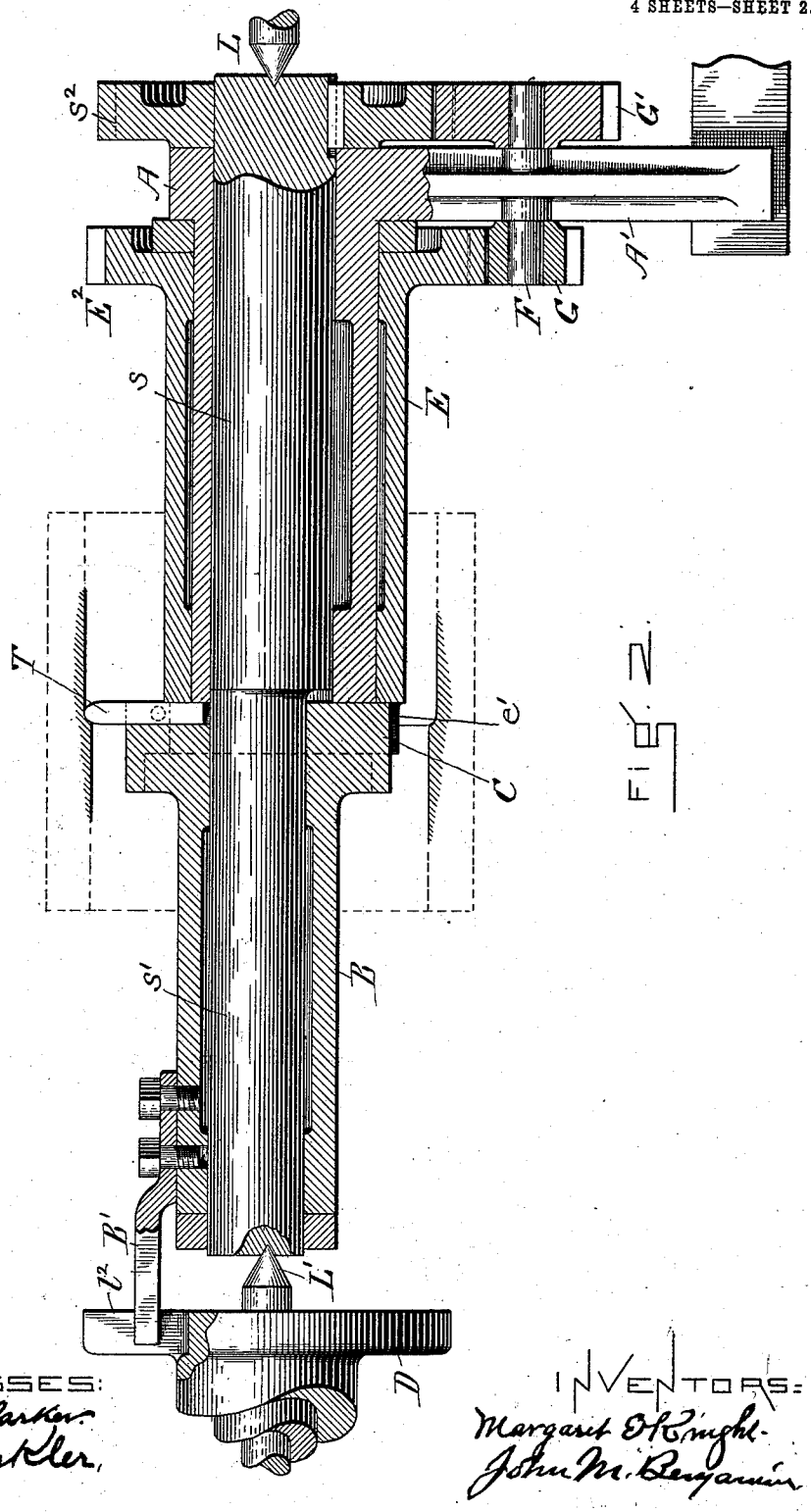


FIG. 2.

WITNESSES:
Frank G. Parker.
John Buckler.

INVENTORS:
Margaret M. Knight.
John M. Benjamin

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 743,293. PATENTED NOV. 3, 1903.

M. E. KNIGHT & J. M. BENJAMIN.

AUTOMATIC TOOL FOR BORING OR PLANING CONCAVE OR CYLINDROIDAL SURFACES.

APPLICATION FILED NOV. 6, 1902.

NO MODEL. 4 SHEETS—SHEET 3.

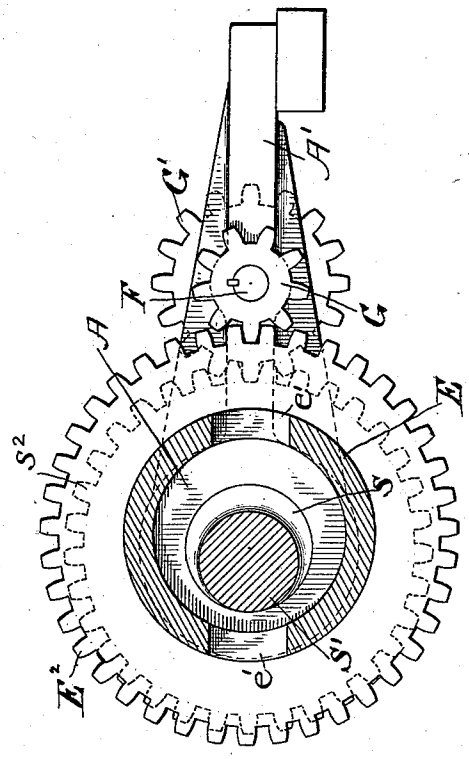


Fig. 4.

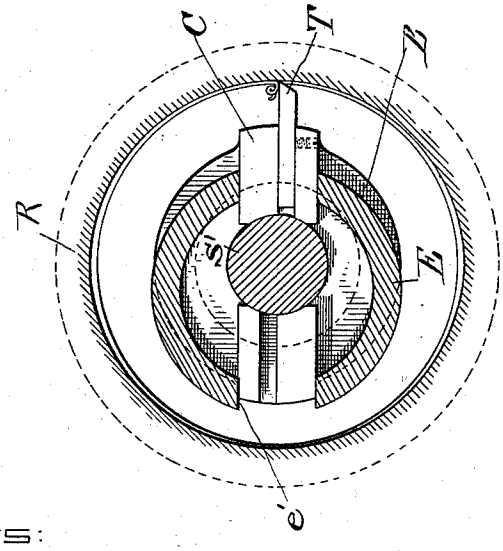


Fig. 3.

WITNESSES:

Frank G. Parker

John Buckler

INVENTORS:

Margaret E. Knight

John M. Benjamin

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 743,293. PATENTED NOV. 3, 1903.

M. E. KNIGHT & J. M. BENJAMIN.

AUTOMATIC TOOL FOR BORING OR PLANING CONCAVE OR CYLINDROIDAL SURFACES.

NO MODEL. APPLICATION FILED NOV. 6, 1902. 4 SHEETS—SHEET 4.

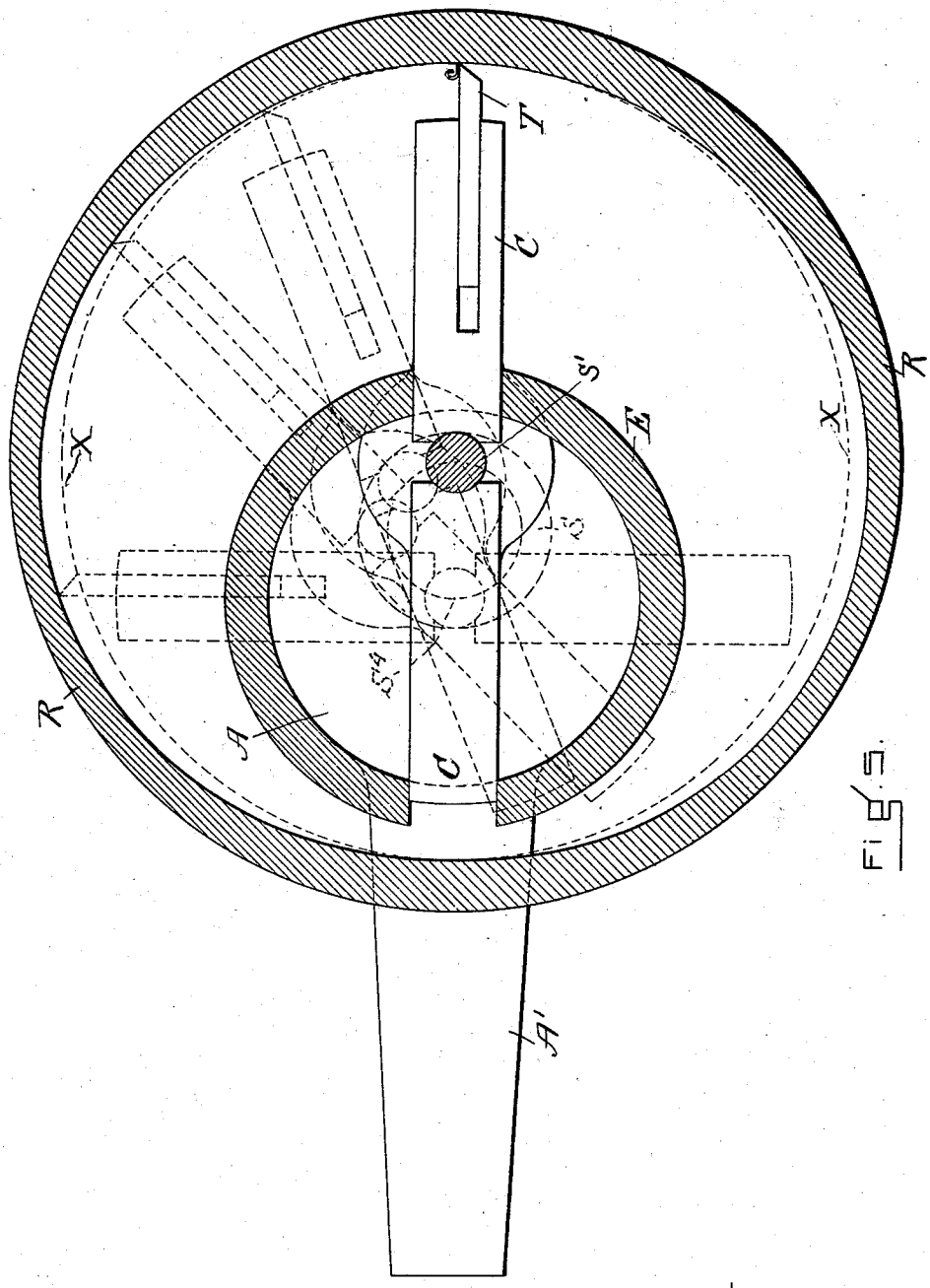


Fig. 5.

WITNESSES:
Frank G. Parker
John Buckler

INVENTORS:
Margaret E. Knight
John M. Benjamin

THE NORRIS PETERS CO., PHOTO-LITHO., WASHINGTON, D. C.

No. 743,293. Patented November 3, 1903.

UNITED STATES PATENT OFFICE.

MARGARET E. KNIGHT, OF SOUTH FRAMINGHAM, AND JOHN M. BENJAMIN, OF BOSTON, MASSACHUSETTS; SAID BENJAMIN ASSIGNOR TO SAID KNIGHT.

AUTOMATIC TOOL FOR BORING OR PLANING CONCAVE OR CYLINDROIDAL SURFACES.

SPECIFICATION forming part of Letters Patent No. 743,293, dated November 3, 1903.

Application filed November 6, 1902. Serial No. 130,263. (No model.)

To all whom it may concern:

Be it known that we, MARGARET E. KNIGHT, residing at South Framingham, in the county of Middlesex, and JOHN M. BENJAMIN, residing at Boston, in the county of Suffolk, in the State of Massachusetts, have invented certain Improvements in Automatic Tools for Boring or Planing Concave or Cylindroidal Surfaces, of which the following is a specification.

The invention relates to automatic tools for boring or planing concave surfaces or cylindroidal chambers, such as the interior of steam-cylinders for rotary engines; and it consists in a rotatable sleeve or cylinder provided with sockets to receive and support the cutting-tools and an eccentric or equivalent mechanism which engages the tool-supporting sleeve and which when rotated differentially to the rotation of that sleeve causes the axis of rotation thereof to revolve in a closed curve that passes through a fixed point which is the axis of revolution of the tool, due to the combined rotation of the eccentric and the tool-support thereon, and at the same time the tool with its support will be caused to reciprocate in a plane which passes through both of the said axes, by which means the cutting-points of the tool will be moved in a cylindroidal path around the said fixed point and will cut a surface with a corresponding curve when the cylindrical casting is fed along in a lathe.

The construction and operation of the improved tool, a specific embodiment of the parts of which are illustrated, will be understood from the description following, in connection with the accompanying drawings, wherein—

Figure 1 is an elevation of the tool as constructed for boring the interior of the steam-chamber for a rotary engine. Fig. 2 is a longitudinal section through the centers of the sleeves and gears which give motion to the eccentric that reciprocates the tool. Fig. 3 is a section on line 3 3, Fig. 1, looking from right to left. Fig. 4 is a section on the same line 3 3 looking from left to right. Fig. 5 is a diagram showing various positions of the tool and its support during a quarter-rotation thereof and a half-rotation of the eccentric. The eccentric portion of the shaft is reduced in size and the sleeve across which the tool-support reciprocates is much enlarged in order to make their relative positions more apparent.

Referring to the drawings, S S′ is a shaft supported on lathe-centers L L′. The end S′ of this shaft is reduced in size and made eccentric to the other portion. The portion S is surrounded by a cylindrical casing A, the exterior surface of which is eccentric to the shaft S and is provided with a projecting arm A′, which may be secured to the lathe-frame to prevent the casing A from turning.

Upon the eccentric-shaft portion S′ is a sleeve B, which at one end has a lug B′ projecting longitudinally thereof and which engages a slot l^2 in the face-plate D of the lathe, so that the sleeve B will revolve with the lathe-head. At the other end of the sleeve B are radially-projecting tenons C, in each of which a cutting or boring tool T may be secured. For ordinary uses one tool will be found sufficient, Upon the cylindrical casing A is another sleeve E, and in the end thereof next to the sleeve B are diametrically radial slots *e′*, (see Fig. 4,) which receive the tenons or projecting portions C of the sleeve B, and by this means the sleeve E is rotated upon the casing A when the sleeve B is turned.

In the arm A′ a short shaft F is journaled, and upon either end of the shaft F small pinions or gears G G′ are keyed. Upon the outer end of the sleeve E is a gear E^2, which meshes with the pinion G, and upon the outer end of the shaft S is a gear S^2, which meshes with the pinion G.′ The sizes of the several gears E^2 G G′ S^2 are so proportioned that the shaft S S′ will rotate twice while the sleeves B E rotate once—that is, as here illustrated, the gear E^2 makes one rotation while the pinion G makes four, and the pinion G′ makes four rotations while the gear S^2 makes two. Consequently the shaft S S′ will rotate twice while the sleeves E B rotate once, and this differential movement of the eccentric shaft S′ and sleeve B will cause the tools T to reciprocate in relation to the fixed point or axis of the sleeve E a distance equal to twice the

eccentricity of the shaft S′ during each rotation of the sleeves B and E and will cause the cutting ends of the tools to move in the cycloidal path shown in Fig. 5. At the same time if the cylinder R is fed along over the tool its interior will be cut in a cylindroidal surface having a corresponding curve.

Referring to the enlarged diagram Fig. 5, S′ represents the eccentric portion of the shaft and the two concentric dotted-line circles the shaft portions S. The inner ring, in section, represents the sleeve E, and the space within the ring E represents the eccentric casing A, C C the tool-holding portions of the sleeve B, while the outer large ring, in section, represents the cylinder R, the interior surface of which is being cut by the tool T. To show the eccentricity of this cylindroidal surface, a true circle X, in dotted lines, is drawn within it. The tool T, with the tool-holding portion C and sleeve B, are represented in dotted lines in three of the different positions which they assume while making a quarter-revolution, and when the portion C has made this quarter-revolution and has assumed the third position indicated, which is at right angles to the initial position, or that shown in full lines, it will be observed that the eccentric portion S′ of the shaft has completed a half-revolution and arrived at the position S^4. During the next quarter-revolution of the tool the shaft portion S′ will have completed one revolution and arrived at its initial position again. While the tool is making the next half-revolution to its initial position again the eccentric-shaft S′ will make another complete revolution. The inner of the two concentric circles S may represent the closed curve in which the axis of rotation of the tool-support is moved by the eccentric S′. The diameter of this closed curve is equal to one-half the maximum reciprocation of the tool with its support during each rotation of the sleeve E. Consequently while the cutting-tool is making one complete revolution within the cylinder R by the rotation of the sleeves B and E the action of the eccentric S′ will cause that tool to reciprocate with reference to the axis of the sleeve E or to make two gradual movements—that is, from one extreme position to the other and back again—diametrically across the sleeve E. It will be apparent, therefore, that when the interior of a cylinder for a rotary engine has been cut by means of this tool the ends of a rigid piston of a length equal to the combined length of the two holders C, with their tools T, when held in a diametrical slot in a revolving hub represented by the ring E will be in constant contact with the inner surface of such a cylinder throughout the entire revolution of the hub, and by the contact of the ends of such a piston with the inner surface of the cylinder it will be caused to reciprocate in the hub in the same manner that the tool-holders C reciprocate in this boring-machine. By varying the degree of eccentricity of the eccentric which carries the tool-support the degree of eccentricity of the cylindroidal surface may be varied, an increase of one increasing the other, and conversely.

I claim—

1. An automatic tool for cutting concave or cylindroidal surfaces, consisting of a cutting-tool, a rotatable support therefor, and mechanism which rotates said support and simultaneously moves its axis of rotation in a closed curve that passes through a fixed point coincident with the axis of revolution of the tool.

2. An automatic tool for cutting continuous concave surfaces, consisting of a rotatable sleeve, a cutting-tool supported therein, and mechanism which engages the sleeve and reciprocates it with the tool radially to the axis of revolution of the tool, and simultaneously moves the axis of rotation of the sleeve in a circle, the diameter of which is equal to one-half the maximum reciprocation of the tool during one revolution.

3. In an automatic tool for cutting concave surfaces, a rotating sleeve, a cutting-tool supported therein, and a shaft, provided with an eccentric located within the sleeve, which eccentric reciprocates the axis of the sleeve with the tool in a plane which always passes through both the axis of rotation and of revolution of the tool when the sleeve and shaft are rotated.

4. In an automatic boring-tool, a shaft which has an eccentric portion, a rotating sleeve upon the eccentric portion, a cutting-tool supported in this sleeve, interconnecting mechanism between the tool-supporting sleeve and said shaft which gives the shaft a rotation differential to that of the tool-supporting sleeve.

5. In an automatic tool for cutting concave surfaces, a shaft which has an eccentric portion, a rotatable support for the cutting-tool upon this eccentric portion, mechanism to rotate the shaft and tool-support in the ratio of two to one respectively, and a cutting-tool held in its support in such relation to the eccentric portion of the shaft that a straight line between the cutting edge of the tool and its axis of revolution will pass through the axis of the eccentric portion of the shaft in every position of the tool throughout its revolution.

MARGARET E. KNIGHT.
JOHN M. BENJAMIN.

Witnesses:
EDITH M. POOLE,
T. S. WATSON.