

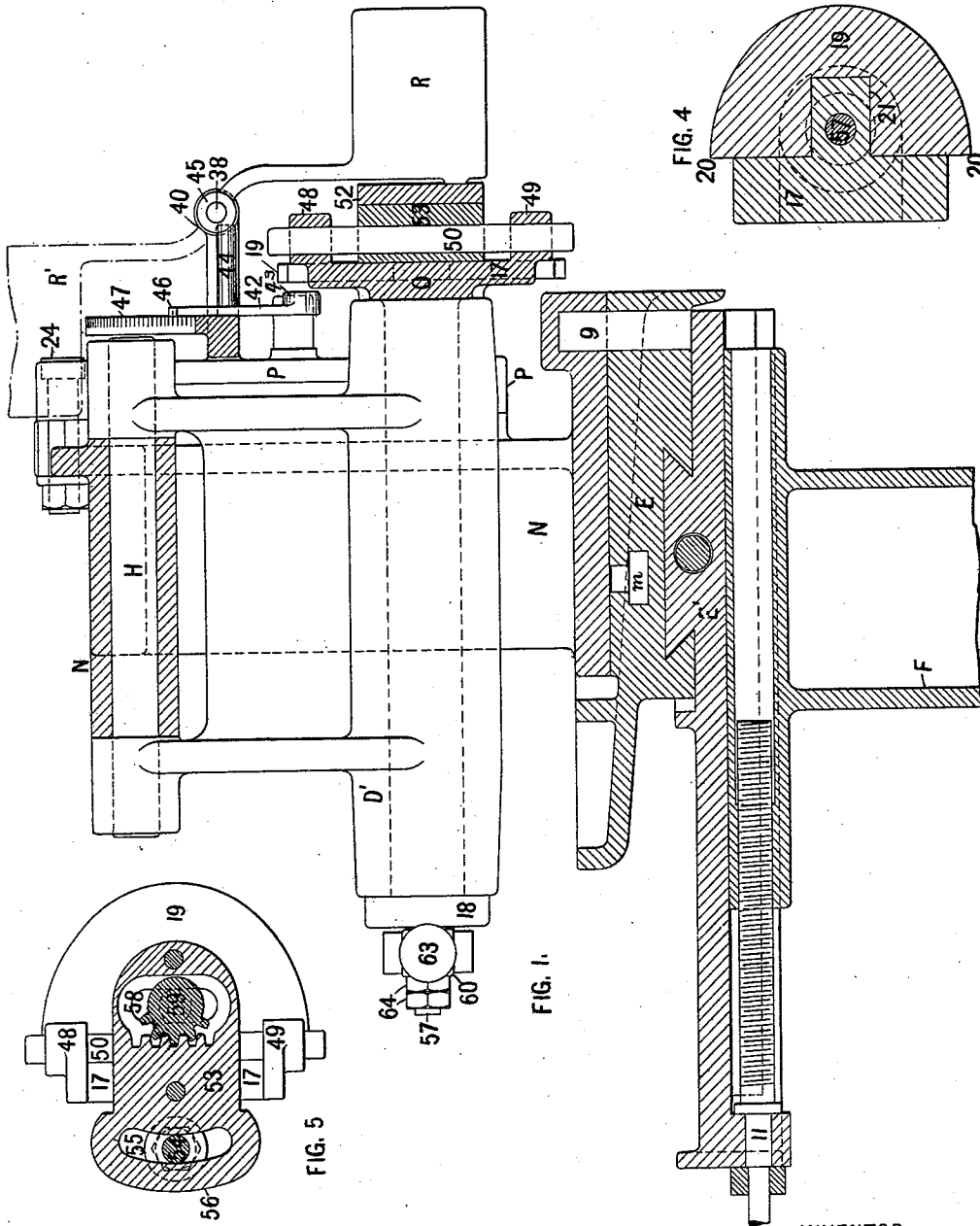
(No Model.)

7 Sheets—Sheet 1.

J. S. BANCROFT.
TOOL GRINDING MACHINE.

No. 460,497.

Patented Sept. 29, 1891.



WITNESSES:
John L. Phillips

INVENTOR
J. S. Bancroft

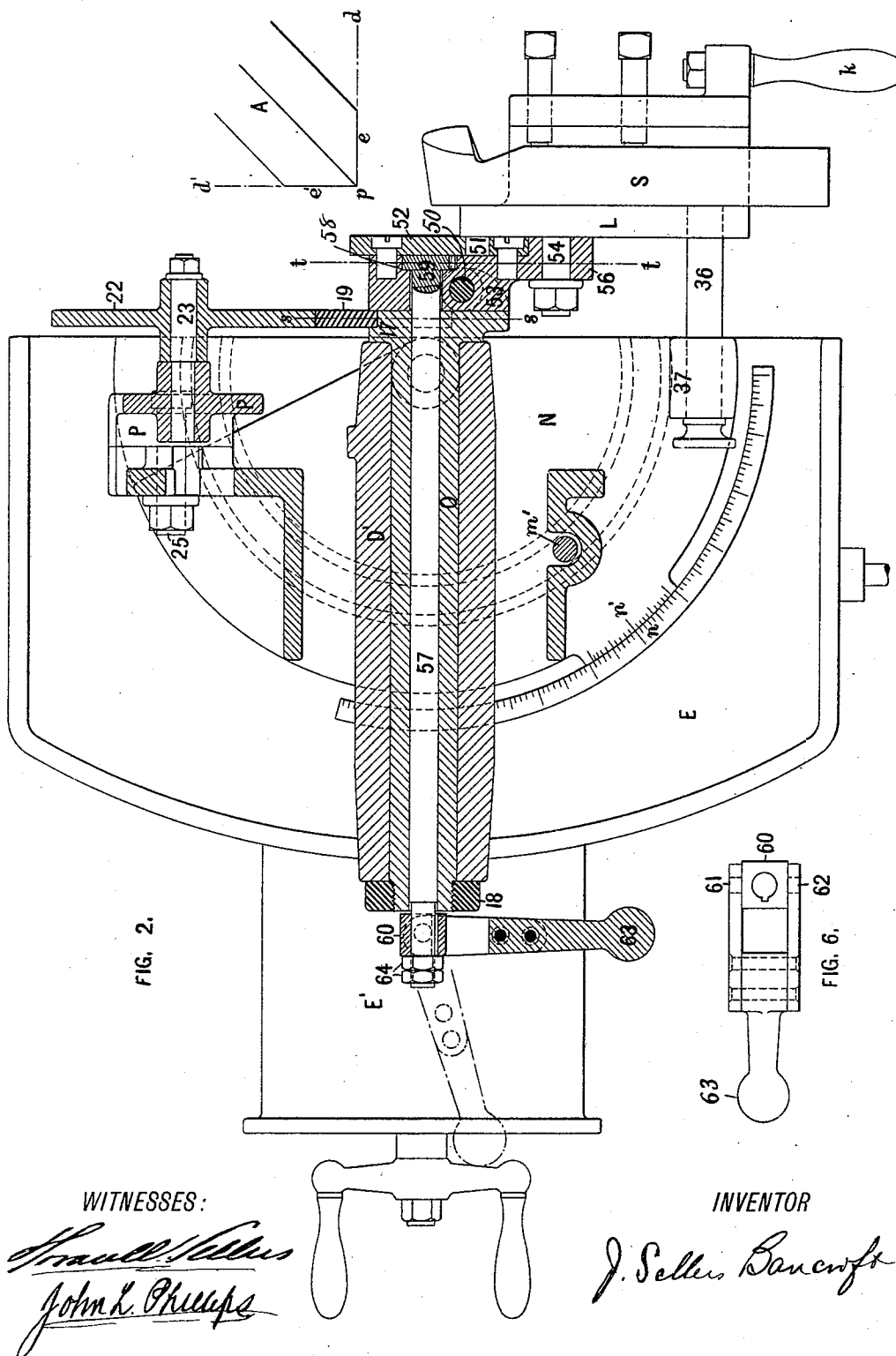
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7 Sheets—Sheet 2.

J. S. BANCROFT.
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Patented Sept. 29, 1891.



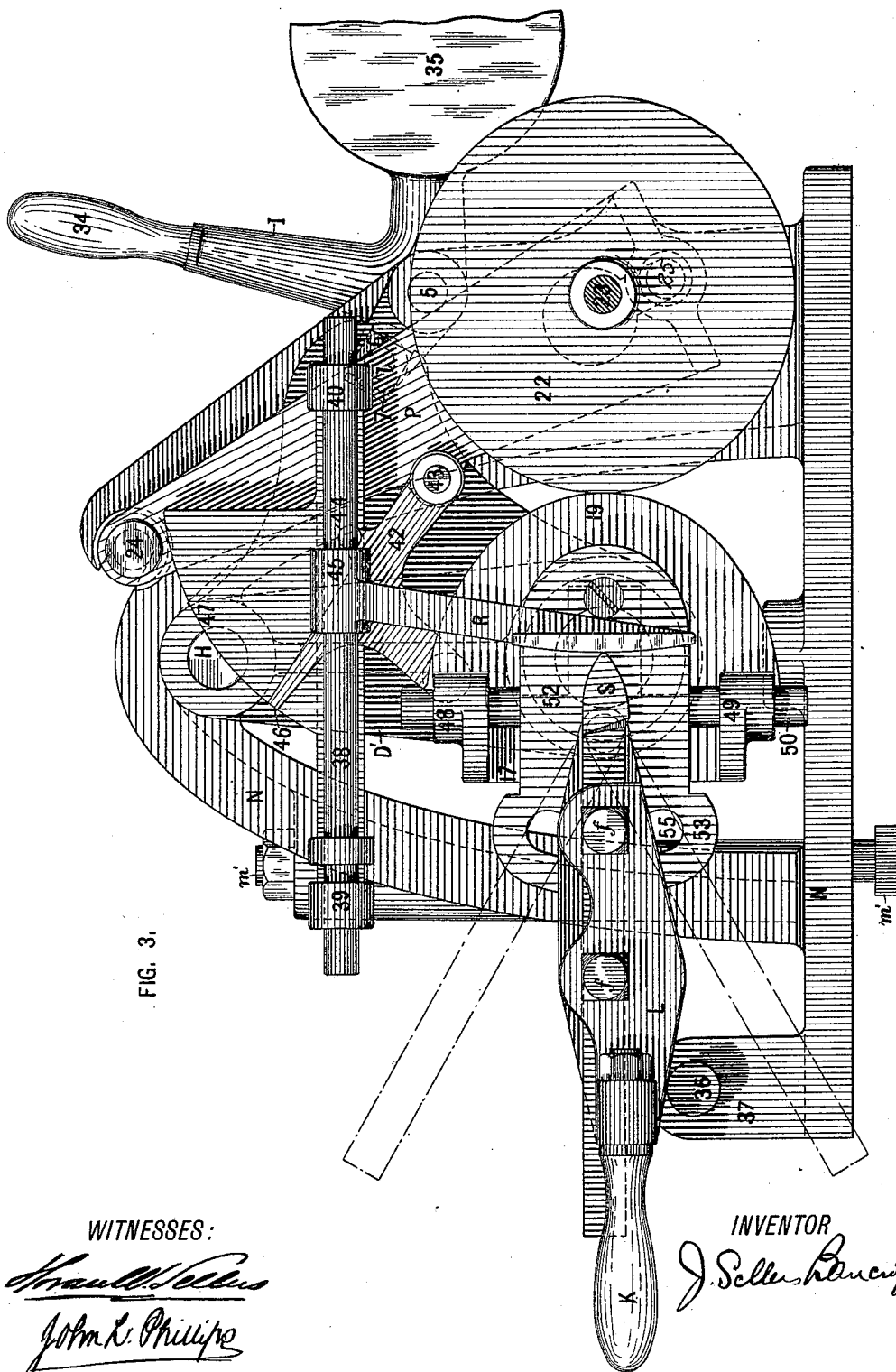
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7 Sheets—Sheet 3.

J. S. BANCROFT.
TOOL GRINDING MACHINE.

No. 460,497.

Patented Sept. 29, 1891.



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(No Model.)

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J. S. BANCROFT.
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Patented Sept. 29, 1891.

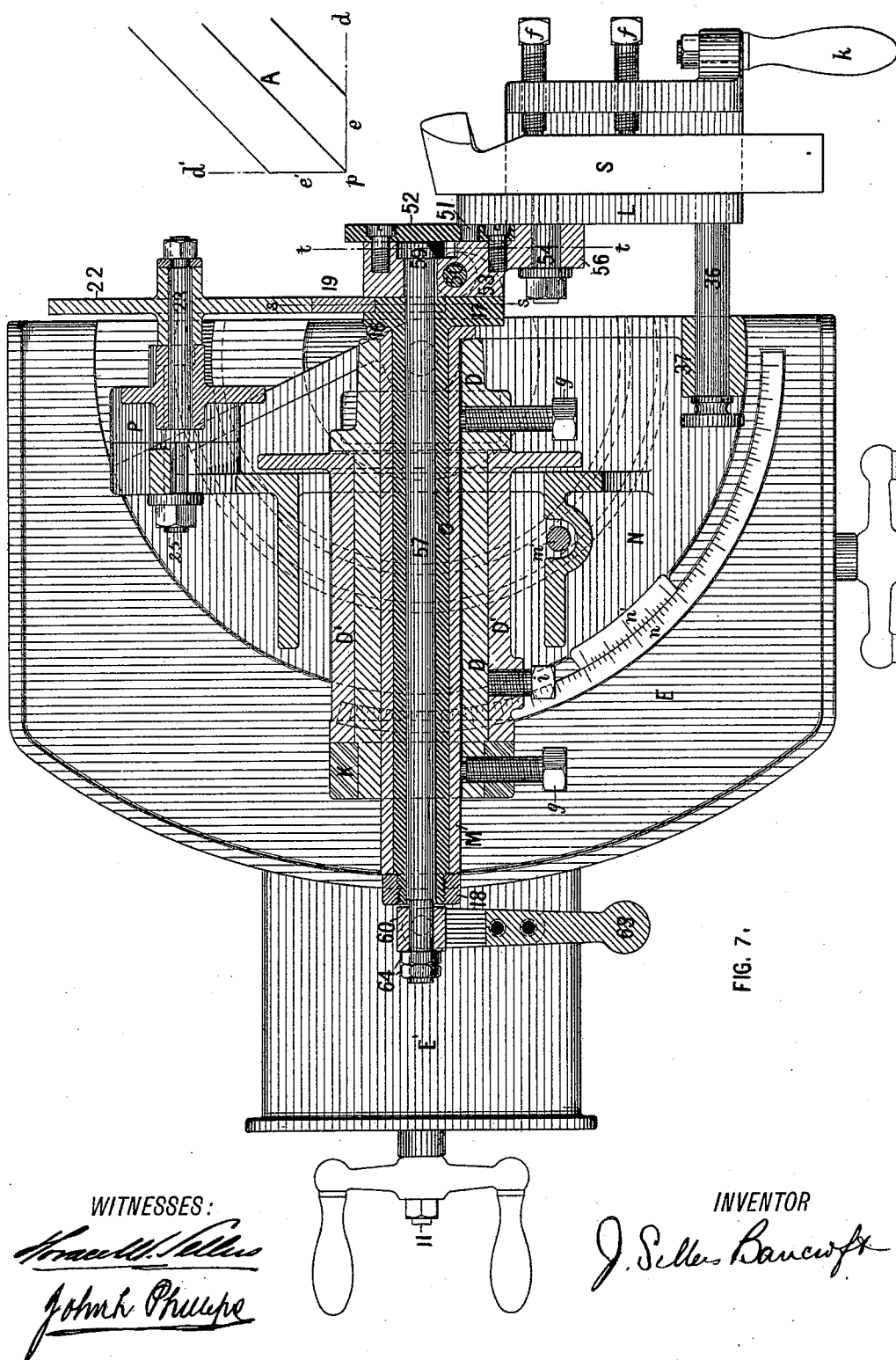


FIG. 7.

WITNESSES:

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(No Model.)

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J. S. BANCROFT.
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FIG. 8.

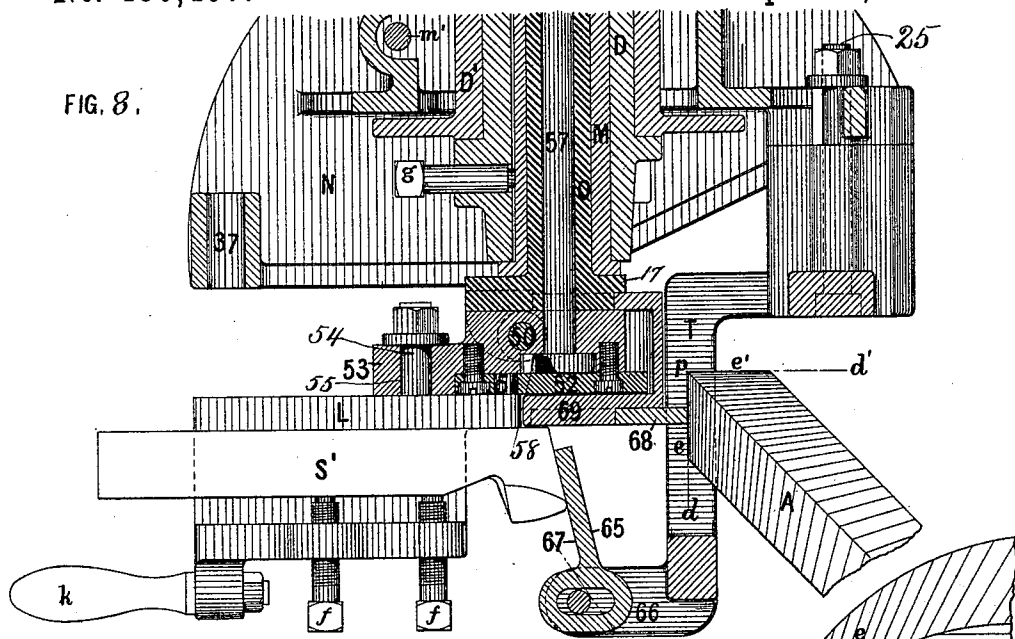
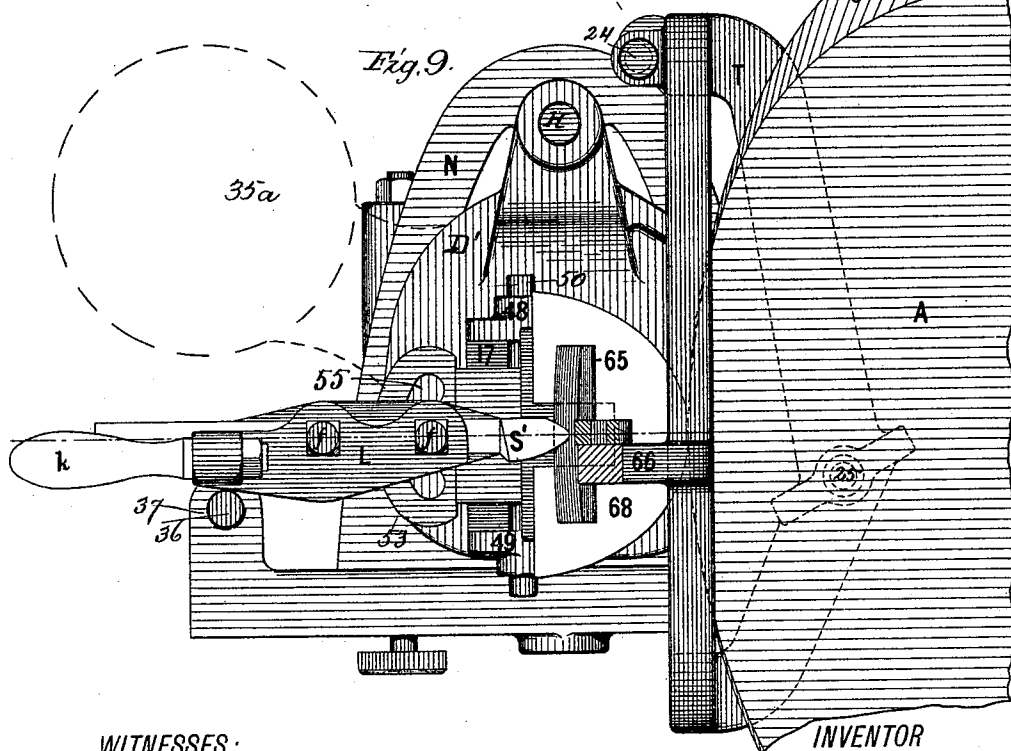


Fig. 9.



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(No Model.)

7 Sheets—Sheet 6.

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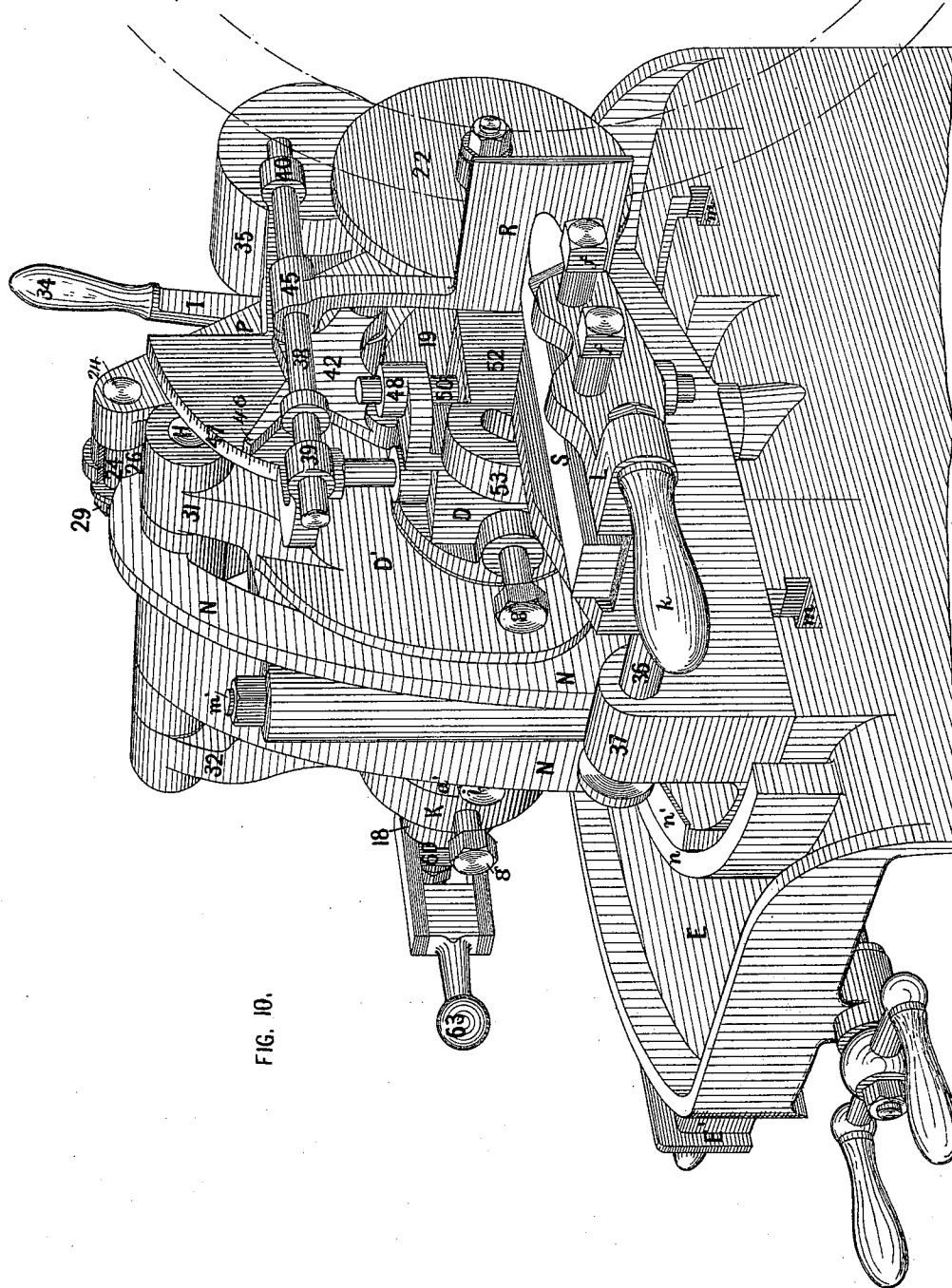


FIG. 10.

WITNESSES:

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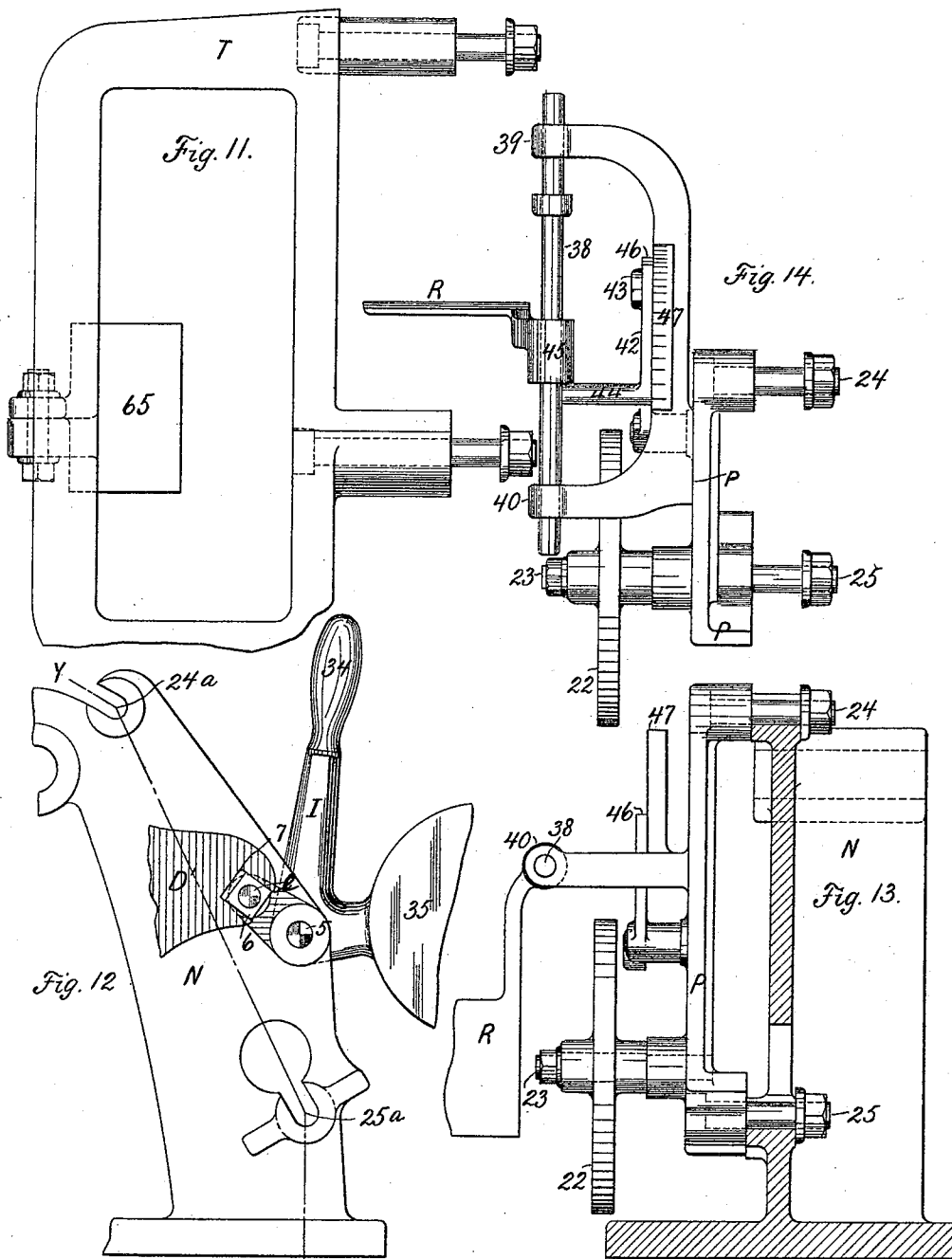
(No Model.)

7 Sheets—Sheet 7.

J. S. BANCROFT.
TOOL GRINDING MACHINE.

No. 460,497.

Patented Sept. 29, 1891.



WITNESSES:

John H. Phillips
E. R. Harper

INVENTOR

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UNITED STATES PATENT OFFICE.

JOHN SELLERS BANCROFT, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR
TO WILLIAM SELLERS & COMPANY, INCORPORATED, OF SAME PLACE.

TOOL-GRINDING MACHINE.

SPECIFICATION forming part of Letters Patent No. 460,497, dated September 29, 1891.

Original application filed May 12, 1887, Serial No. 237,986. Divided and this application filed November 15, 1889. Serial No. 330,460. (No model.)

To all whom it may concern:

Be it known that I, JOHN SELLERS BANCROFT, of the city and county of Philadelphia, and State of Pennsylvania, have invented certain new and useful Improvements in Tool-Grinding Machines, of which improvements the following is a specification.

My invention relates to a device for forming by grinding the curved faces and cutting-edges of cutting-tools used on machine-tools. In order to produce the best output from machine-tools in the two essentials of quality and quantity, the shape of the cutting-tools which remove the material is an exceedingly important factor. In most shops the shapes of these tools have been and are left to the judgment of the individual operator, with the result that few, if any, tools in such shops are made in the best shapes.

It is an object of my present invention to provide means for rapidly and economically forming by grinding the working faces of metal-cutting tools.

It is a further object of my invention to provide means whereby these faces can be accurately formed and located with reference to each other and to the shank of the tool.

It is a further object of my invention to provide means whereby an existing tool can be used to produce a record of its shape, which record will enable the operator to produce similar tools; and to these ends my invention consists in providing an oscillating tool-holding chuck in which the tool to be ground may be held with its shank approximately at right angles to the axis of oscillation, and in so arranging the supporting-bearing for this chuck that it may be set at any desired angle with a tangent plane of the grinding-wheel and in mounting this bearing upon two slide-rests at right angles with each other, whereby cylindrical or conical surfaces may be produced upon a tool held in the chuck; and it further consists in providing means whereby the axis of this oscillating chuck may have a vibrating motion to and from the wheel for the purpose of varying the contour of the tool; and it further consists in providing this oscillating chuck with a former-plate, which determines the amount

and relation of the vibrating movement; and it further consists in providing means for altering the relative positions of the former-plate and the shank of the tool to be ground, whereby the relative position of the curved cutting-edge of the tool to its shank may be varied, as required; and it further consists in providing a movable indicator by which the position of the tool to be ground may be determined relatively to the axis of the oscillating chuck; and it further consists in so arranging this movable indicator that the position and relation of the tool to be ground can be determined with reference to the former-plate; and it further consists in providing an indicator which is moved in one direction by the tool to be ground and in the opposite direction by gravity or a spring; and it further consists in providing this indicator with an index and suitable graduations by which the size of the tool may be measured, either in radial distance from the axis of the chuck or relatively to the former-plate, whereby tools of varying sizes and outlines can be formed from the same former-plate; and it further consists in providing means by which a curved-face tool can be used as a templet to control the vibrating motion of the oscillating chuck, whereby a former-plate can be ground to the proper contour for reproducing similar tools.

In the accompanying drawings, which form part of this specification, Figure 1, Sheet 1, represents a side elevation, partly in section, of one form of my present invention shown as mounted upon the slide-rest E, described and shown in my application filed May 12, 1887, Serial No. 237,986, of which this application is a division. Fig. 2, Sheet 2, is a horizontal section through the axis of the oscillating chuck shown in Fig. 1. Fig. 3, Sheet 3, is an end elevation showing a tool in place to be ground, with the former-plate, abutment, and indicator. Fig. 4, Sheet 1, is a sectional elevation of the former-plate and part of the oscillating chuck which carries it, taken on the line *s s* of Fig. 2. Fig. 5 is an end view, partly in section, on the line *tt* of Fig. 2, of part of the apparatus for altering the relative position of the former-plate and the shank of the tool. Fig. 6, Sheet 2, shows the hand-lever by

which the parts are adjusted and secured. Fig. 7, Sheet 4, is a horizontal section through the axis of the oscillating chuck when arranged to be inserted in an adjustable rotatable chuck arranged with a vibrating movement. This is the form I prefer, whereby one machine is made capable of grinding all forms of tools. Fig. 8, Sheet 5, is a horizontal section through the front end of the oscillating chuck shown in Fig. 7, with the parts in place ready to grind a former-plate to conform to a finished tool. Fig. 9 is an end elevation of the same parts. Fig. 10, Sheet 6, is a perspective view of the oscillating tool-holding chuck mounted in its vibrating bearing carried by the supporting-bearing, with the indicator in position for adjusting a tool to place, indicating by broken lines the position of the grinding-wheel. Fig. 11, Sheet 7, is a side elevation of the stand T, shown in Figs. 8 and 9. Fig. 12 is a view of part of the adjustable bearing with the counter-weight and connections. Fig. 13 is a section through Fig. 12 on the line *y y*, showing the indicator-stand in position. Fig. 14 is a plan of the indicator.

In all the figures similar letters and numerals refer to similar parts.

The supporting-bearing N is shown in Figs. 1 and 2 in position upon the slide-rests E' and E, described in a division of this application. It is provided with a bearing to fit on the pin 9, about which it swivels, and with a clamping-bolt *m'*, by which it is secured at the proper angle to give the desired clearance to the tool. It is provided with a fixed index and vernier *n'*, adjoining the flange *n*, and when this index coincides with the ninety-degree point of the graduations on the flange *n* the horizontal axis of the oscillating chuck is parallel with the tangent plane of the abrading-surface of the grinding-wheel.

A tool S, with curved face, is shown in Figs. 2, 3, 7, and 10 as secured in position in the clamping-jaw L of the oscillating chuck, the jaw L being formed with or secured adjustably or otherwise to a journal O, turning freely within the vibrating bearing D', the axis of the journal being the axis about which the oscillating chuck oscillates. This journal is provided with a flange 17 and on the other end with a collar or nut 18, which together prevent all end motion. The flange 17 is formed, as indicated in Fig. 4, so as to provide a seat for the several former-plates required, 19 being a representation of one of them. One edge 20 20 of the former-plate is made straight, with a rectangular notch or recess 21 formed in it, as shown in Fig. 4, the straight edge and recess fitting a corresponding straight edge and tongue formed on the flange 17. By this arrangement the former-plates are accurately and securely located with reference to the axis of the oscillating chuck, while at the same time they can readily be removed and replaced.

The former-plate 19 is shown as resting against an abutment, which I prefer to make

in the form of a roller 22, in order to reduce the friction. This roller 22 is carried by and revolves freely on the stud 23, secured in the stand P, which is provided with two bolts 24 25, which engage with the slots 24^a and 25^a, (see Fig. 12,) and thus secure it to the adjustable supporting-bearing in the same manner as the stand T, which replaces it, as shown in Figs. 8 and 9. The vibrating bearing D' is pivoted on or swung from the shaft H, secured in the upper part of the arch in the adjustable bearing N. By swinging the bearing D' the axis of the journal O, which is the axis of the oscillating chuck, is vibrated toward and from the grinding-wheel in a path which is determined by the distance from the shaft H to the axis of the journal O.

The counterweight-lever I, pivoted at 5 in the supporting-bearing N, (see Fig. 12,) is provided with a pin *l* and block 6, which engage with a slot 7, formed in an arm of the vibrating bearing D', and by which the bearing D' is forced toward the right, as shown in Fig. 3, and by which pressure the former-plate 19 is pressed against the abutment-roller 22. The function of the counter-weight is to hold the former-plate against the abutment with sufficient force to insure the vibrating motion of the chuck, and provided this result is accomplished the counter-weight may be arranged in any desired way. By properly proportioning its weight and position it may be rigidly secured to the vibrating bearing D'. (See 35^a, Fig. 9.) The former-plate 19 is made of such size that when it rests against the roller 22 the vibrating bearing D' can at no time strike against either side of the arch on the bearing N, which supports it, and hence the former-plate 19 will be held to its seat in the flange 17 and against the roller 22 by a force due to the weight of the counter-weight 35 multiplied by the leverage through which it acts.

The jaw L is shown in Figs. 2 and 3 as resting upon a pin 36, which slides freely in and is guided by a bearing 37, formed with or secured to the adjustable bearing N. This pin 36 serves to support the jaw L in a horizontal position for greater convenience in placing or removing the tool. During the operation of grinding the pin 36 is drawn back, allowing the jaw L of the oscillating chuck to oscillate freely about its axis in the vibrating bearing D' to the extent of about one hundred and eighty degrees, as may be required for presenting the contour of the tool held in the chuck to the abrading-surface *e* of the grinding-wheel. If the curved shape of the former-plate is circular, with its center coinciding with the axis of the oscillating chuck, there will be no vibrating motion of the axis to and from the grinding-wheel as the chuck is oscillated, and the motion and the shape produced will be the same as though the former were removed and the vibrating bearing D' rested against the side of the arch of the adjustable bearing N, or as though the oscillat-

ing chuck were journaled directly in the bearing N, and the contour produced upon the tool held in the jaw L would be circular, the axis coinciding with the axis of the oscillating chuck and the radius depending upon the distance that the end of the tool projects beyond this axis toward the grinding-wheel. If the former is of any shape other than circular—as, for example, as shown in Fig. 3—then as the chuck is oscillated about its axis the former-plate 19, acting in one direction and the counter-weight 35 in the opposite direction, will cause the bearing D', and with it the axis of the oscillating chuck, to vibrate to and from the abrading-surface *e* of the grinding-wheel to the extent of the eccentricity of the former-plate, and a tool S, held in the oscillating chuck, would be ground to a shape parallel to the contour of the former-plate, and its size or the distance between these two parallel curves can be measured by the movable indicator hereinafter described. As the grinding-wheel and the abutment-roller 22 are both on the same side of the axis of the oscillating chuck, it follows that in grinding a tool in this chuck, the pressure of the former-plate against the roller 22 is diminished by the amount of the pressure of the tool against the grinding-wheel, and that this latter pressure cannot exceed that due to the counter-weight 35 multiplied by the leverage through which it acts. By adjusting either the weight of this counter-weight or the leverage through which it acts the maximum pressure which can be exerted on the tool can be determined and limited.

For the purpose of determining the distance that a tool S should project beyond the axis of the oscillating chuck when clamped in its jaw L, I provide the movable indicator R. (Shown in position as against the end of the tool in Figs. 1, 3, 10, 13, and 14, the part which bears against the tool being curved to correspond with the average curvature of the abrading-surface of the grinding-wheel.) The indicator R is secured to the shaft 38, which turns and slides freely in the bearings 39 and 40 in the stand P. (See Figs. 1, 3, 10, 13, and 14.) A weighted lever 42, pivoted on the stud 43, secured in the stand P, is provided with an arm 44, which rests against the hub 45 of the movable indicator R. The weight of the lever 42 is sufficient to slide the shaft 38 through its bearings, and so presses the indicator R against the end of the tool S. The lever 42 has an index 46, which moves along a graduated arc 47 on the stand P, concentric with the pivot 43, and as the tool S is pushed forward in the jaw L the index rises, and when the proper graduation is reached, sufficient allowance being made for the amount of metal to be removed by grinding, the tool is clamped fast in the jaw L and the movable indicator swung up out of the way into the position shown by the broken line in Fig. 1 at R'. Before removing the tool from the chuck

the slide-rest on which the bearing N is carried is run back and the indicator R swung down, so as to rest against the end of the tool, as before, when the index 46 on the arm 42 will indicate on the graduated arc 47 a number corresponding to the size of the tool, and thus enable the operator to grind the tool to the desired size without any other gage than is afforded by the indicator.

In the foregoing description the jaw L of the oscillating chuck has been described as though it was formed with or rigidly secured to its journal O, turning in the bearing D', and for many purposes such an arrangement would be sufficient. To adapt the machine, however, to more general use and to reduce the number of former-plates required and the time of changing them and of grinding unnecessary material from certain tools, I prefer to attach the jaw L adjustably to the journal O, whereby a bent tool may be ground with the same facility as a straight one and with the same former, and any tool held in the jaw L may be moved transversely to the axis of the chuck to equalize the amount of metal to be removed from its two sides. To grind the bent tool above referred to, the chuck-jaw L has a pivoted connection with the cover-plate 52, firmly secured to the slide-rest 53, and for this purpose is provided near its forward end with a pivot-pin 51, which fits into and turns easily in a bearing provided in the cover-plate 52. The jaw L is provided with a bolt 54, which passes through a curved slot 55 in the slide-rest 53 and serves to secure the jaw L firmly to the slide-rest 53 when it has been adjusted to the proper angle for the shank of the tool, as determined by graduations provided on the end face 56 of the slide-rest 53. The slide-rest 53 has firmly secured in it the pin 50, which slides in and is guided by the bearings 48 and 49, formed on the flange 17 of the journal O, whereby the slide-rest can be moved in a plane at right angles to the axis of the oscillating chuck between the bearings 48 and 49 without changing the angle at which the jaw L may be secured. The slide-rest 53 may be pivoted to an extension of the flange 17, so as to swing across in an arc of a circle, instead of sliding in a straight line. I have constructed the slide-rest in this way, but prefer the method shown, as making no change in the angle of the tool-shank in adjusting. A locking-bolt 57 passes freely through a hole bored through the journal O and the countersunk slot 58 in the slide-rest 53 and is provided at one end with a head 59, which engages in this slot 58 and by which the slide-rest 53 may be firmly secured to the flange 17, when desired. A part of the periphery of this head 59 is provided with teeth, as shown in Fig. 5, which engage with corresponding rack-teeth in the slide-rest 53, whereby rotation of the locking-bolt 57 will move the slide-rest between the bearings 48 and 49 and end movement of the

bolt will clamp the slide-rest firmly to place. On the other end of the bolt 57 is keyed, so as to turn with it, the fulcrum-block 60, which is provided with two trunnions 61 and 62, which carry the adjusting-lever 63. This is made in three pieces, as indicated in Fig. 6, for convenience in manufacture, and the holes in the two side plates which fit on the trunnions 61 and 62 are eccentric to the rounded ends of the side plates. The block 60 is adjusted to position on the locking-bolt 57 by the lock-nuts 64, and when the lever 63 is in the position shown in Fig. 2 the locking-bolt 57 is perfectly free and may be rotated and the slide-rest 53 adjusted up or down by the rack and pinion by moving the lever 63 up or down, which movement turns the fulcrum-block 60 and with it the locking-bolt 57. When the slide-rest is in the desired position, the lever 63 is swung on the trunnions 61 and 62 in a plane at right angles to the adjusting movement, so as to bring it more into line with the bolt 57, as shown in broken lines in Fig. 2. This movement forces the eccentric ends of the side plates of the lever 63 against the end of the journal O or the nut 18, which transmits the pressure to the journal O and thus draws the bolt 57 back until the slide-rest 53 is, by means of the head 59, firmly clamped against the enlarged end of the journal O. The slide-rest 53 also covers part of the former plate 19, which is made slightly thicker than the depth of the seat provided for it in the flange 17, so that the operation of clamping the slide-rest also clamps the former-plate. The cover-plate 52, which carries the pivot of the jaw L, is secured firmly to the slide-rest 53 and serves, also, to protect the rack-and-pinion adjustment of the slide-rest from grit and water and as a stop to support the indicator R at the proper height for measuring. (See Fig. 1.)

The operation of adjusting a tool to be ground in this form of the oscillating-chuck is as follows: A tool S, Fig. 3, is laid on the jaw L in the position shown, if its shank is straight. If the shank is bent either right or left hand, as indicated by the broken lines, the jaw L is adjusted and clamped by the bolt 54 to the proper angle in the slide-rest 53. It will be noticed that the end of the tool to be ground bears the same relation to the former-plate 19, whether its shank is straight or bent. The tool is now pushed forward in the jaw L, the indicator R being in position, as shown, until the index 46 indicates the proper figure for a tool of the given size and shape, as noted in a table giving the settings for the various tools the machine is required to grind. It is then secured in the jaw L by the set-screws *ff*, the pin 36 is withdrawn, and the jaw L, carrying the tool S, is oscillated about the axis of the journal O by the handle K, the indicator R still bearing against the tool. If when the handle K is in its high-

est and lowest position the reading of the indicator is nearly alike, the tool is properly adjusted and may at once be ground. If, however, the readings in the highest and lowest positions vary considerably, then the operator, taking the adjusting-lever 63 in his left hand, moves it so as to release the slide-rest 53 and then swings it about the axis of the chuck, so as to move the slide-rest into such a position that the reading of the indicator is as nearly equal as possible in all positions of the chuck, when the adjusting-lever 63 is moved so as to reclamp the slide-rest 53. After the tool has been ground the indicator should be used to show whether the end has been reduced to the proper size. The clearance of the tool—that is, the angle which any element of the curved surface makes with a line perpendicular to the base of the tool—is obtained by setting the supporting-bearing N at the desired angle, as indicated by the index *n'*. As the shape produced on the tool is parallel to the curved outline of the former-plate, it is possible to vary the shape as well as the size of the tool by using a former-plate elliptical in outline, having its focus between the axis of the chuck and the periphery of the former. Then if the end of a tool is at this focus it will be ground to a sharp point, and by varying the distance that the tool projects beyond this focus the radius of curvature of the end of the tool may be varied to any desired extent. The contour of the tool will be exactly parallel to the curve of the former-plate only when the points of tangency of the plate and roller and of the tool and grinding-wheel are in the same plane with the axes of the grinding-wheel, the roller, and the oscillating chuck. If there is much difference in the radii of the roller and grinding-wheel, together with large eccentricity in the former-plate, then the point of tangency will not remain in the same plane and the curve will not be exactly parallel.

In the oscillating chuck hereinbefore shown and described the adjustable bearing N has been described as fitting on the slide-rest E. (Shown in a division of this application, Serial No. 237,986, filed May 12, 1887, and taking the place of the adjustable supporting-bearing therein shown and described.) It is not necessary, however, that the machine on which this oscillating chuck is used should be provided with a vertical slide-rest, neither is it essential that the grinding-wheel should be of the double conical form therein shown and described, for as this chuck is for the purpose of grinding curved outlines only it may be used with a plain cylindrical wheel, and the grinding may be done on the face or the side of the wheel, as may be found most convenient. The construction I prefer is shown in plan section in Fig. 7, the vibrating bearing D' being enlarged, so as to receive the rotatable tool-holding chuck D, provided with clamping-screws and index and gradua-

tions and adapted to receive and hold tools the cutting-edges of which are formed by the intersection of plane surfaces, as described and shown in my application, Serial No. 237,986, of which this is a division, and it is also capable of receiving the sleeve M, which is a bearing for the journal O of the oscillating chuck hereinbefore shown and described. In this arrangement the rotatable tool-holding chuck is capable of receiving a vibrating motion to and from the grinding-wheel, and either plane or curved faced tools may be ground by removing or inserting the bearing M, with its attached parts. When the shape of a tool has been determined by experiment for any particular case, it is desirable to be able to record and reproduce this shape. Suppose the tool S, Fig. 3, to be a tool to be recorded. Then if the indicator R be clamped to place so as not to slide back and forth and an emery-wheel be put in the place of the roller 22 it will be clear that as the chuck is oscillated the tool S, bearing against the indicator, will cause the chuck to vibrate to and from the grinding-wheel, and the former-plate 19 would be ground to correspond with the shape of the tool S.

By reference to Figs. 2 and 7 it will be seen that by removing the roller 22 the former 19 could be brought into position by the slide-rests to be ground by the grinding-wheel A. This method would, however, require the indicator to be made heavier than would be necessary or convenient for ordinary use, and I therefore provide for this purpose the stand T, Figs. 8, 9, and 11, which is secured to the supporting-bearing N in the same manner and at the same bearing-points as the stand P, which is removed for this purpose. A movable abutment-plate 65, secured to the arm of the stand T, takes the place of the indicator R, as above described, and to have more room to grind the former-plate blank 68 it is secured to a block 69. (Shown as clamped by the slide-rest 53 in the same seating as is provided for the former-plate 19.) This block merely serves to hold the former-plate blank in a more convenient position relatively to the grinding-wheel without in any way changing its relation to the axis of oscillation of the chuck or the tool to be recorded. When the former-plate blank is ground to shape, the block 69 is removed and the finished former-plate put in the seat provided in the flange 17. The stand T is removed and the stand P, carrying the indicator R, replaced, and the reading of the index 46 is then taken and recorded, and a duplicate tool can then be made at any time which will be precisely similar to the sample, or tools larger or smaller can be made by varying the reading.

Having now described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a tool-grinding machine, an oscillat-

ing tool-holding chuck mounted upon a bearing which is adjustable about an axis at right angles to the axis of oscillation, in combination with two slide-rests which support and move the bearing, for the purpose set forth.

2. In a tool-grinding machine, an oscillating tool-holding chuck and a supporting-bearing adjustable about an axis at right angles to the axis of oscillation, in combination with a vibrating bearing hinged to the supporting-bearing and connecting the oscillating chuck and the supporting-bearing, for the purposes set forth.

3. In a tool-grinding machine, an oscillating tool-holding chuck adapted to receive a vibrating motion to and from an abrading-surface of a grinding-wheel, a supporting-bearing adjustable about an axis at right angles to the axis of oscillation, and an abutment, in combination with a former-plate which determines the amount and relation of the vibrating movement of the chuck.

4. In a tool-grinding machine, an oscillating tool-holding chuck, a vibrating bearing, and a former-plate with its abutment, in combination with a slide-rest, which determines the distance between the axis of oscillation and the shank of a tool or of the former-plate.

5. In a tool-grinding machine, an oscillating tool-holding chuck, a vibrating bearing, an abutment, a former-plate, and a slide-rest for adjusting the relative position of the tool and the former-plate, in combination with a locking-bolt coupled to the slide-rest.

6. In a tool-grinding machine, an oscillating tool-holding chuck, a vibrating bearing, a former-plate with its abutment, and a slide-rest provided with a rack, in combination with a locking-bolt provided with a toothed head.

7. In a tool-grinding machine, an oscillating tool-holding chuck, a vibrating bearing, an abutment, a former-plate, a slide-rest, and a locking-bolt, in combination with an adjusting-lever.

8. In a tool-grinding machine, an oscillating tool-holding chuck, a vibrating bearing, a former-plate carried by the chuck, and an abutment, in combination with a pivoted connection between the chuck-jaw and the former-plate.

9. In a tool-grinding machine, an oscillating tool-holding chuck, a vibrating bearing, and a supporting-bearing, in combination with a counterweighted lever pivoted to the supporting-bearing and connected to the vibrating bearing of the oscillating chuck.

10. In a tool-grinding machine, an oscillating tool-holding chuck, in combination with a movable indicator.

11. In a tool-grinding machine, an oscillating tool-holding chuck, a slide-rest, and a former-plate, in combination with a movable indicator.

12. In a tool-grinding machine, a tool-hold-

ing chuck, in combination with an indicator which is movable into contact with the surface upon which the grinding-wheel is to operate or has operated.

- 5 13. In a tool-grinding machine, a vibrating bearing and an oscillating tool-holding chuck adapted to hold a blank former-plate and the

tool to be copied, in combination with an abutment.

J. SELLERS BANCROFT.

Witnesses:

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JOHN L. PHILLIPS.