A. GEIGER.

GRADUATING MACHINE.

APPLICATION FILED MAY 9, 1902.

921,824.

Patented May 18, 1909.

4 SHEETS—SHEET 1.

Fig. I.

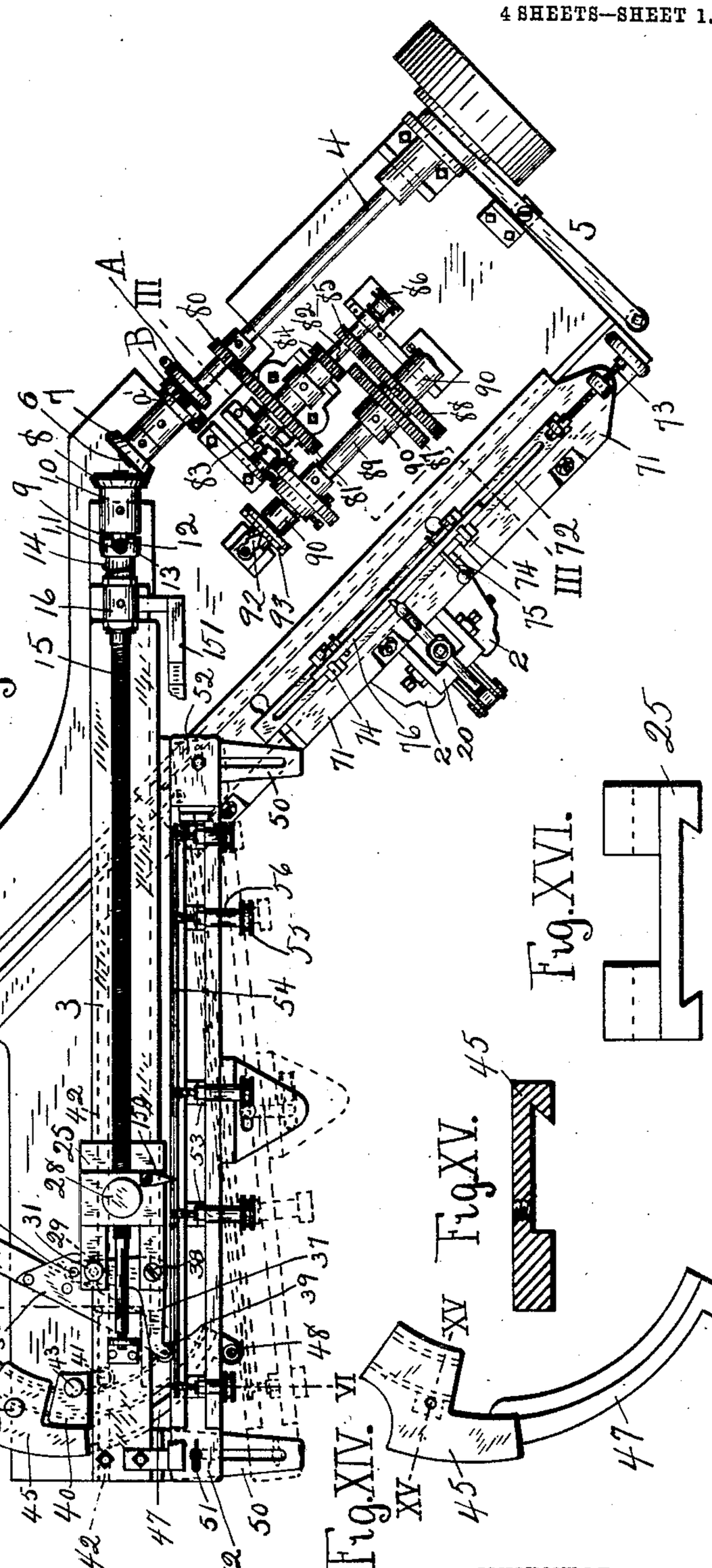

Fig. XII.

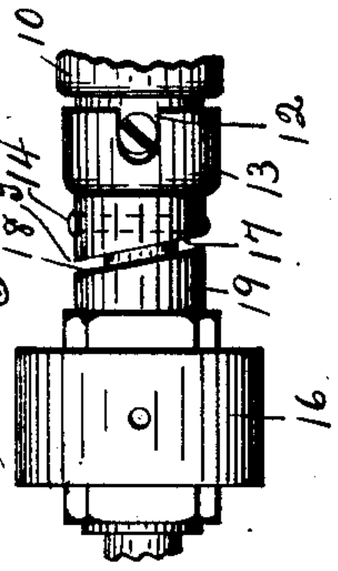

Fig. XIII.

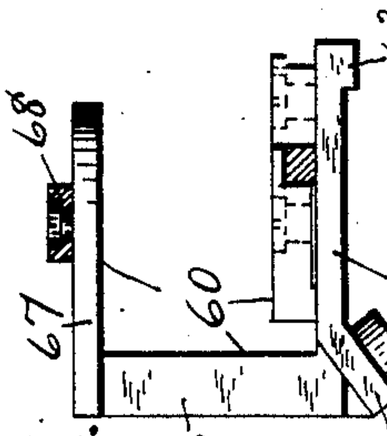

Fig. XVI.

Fig. XV.

Fig. XIV.

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4 SHEETS—SHEET 2.

Fig. V.

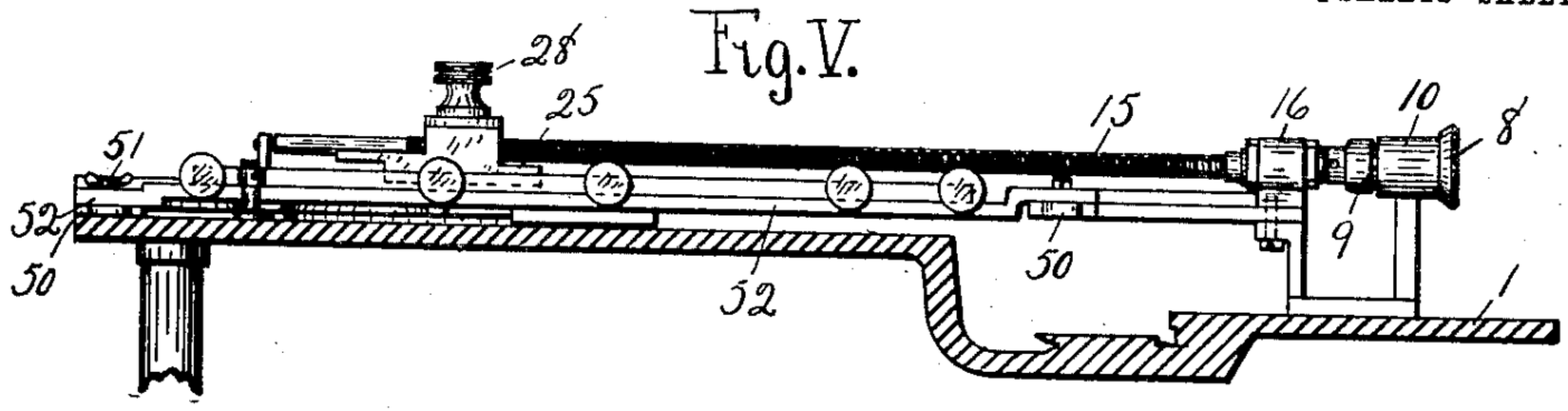


Fig. II.

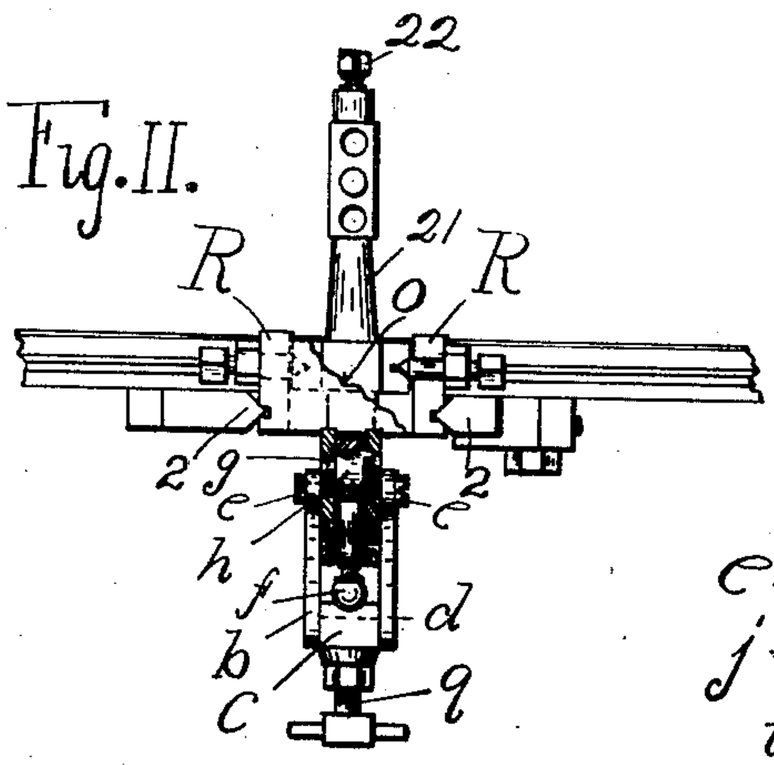


Fig. X.

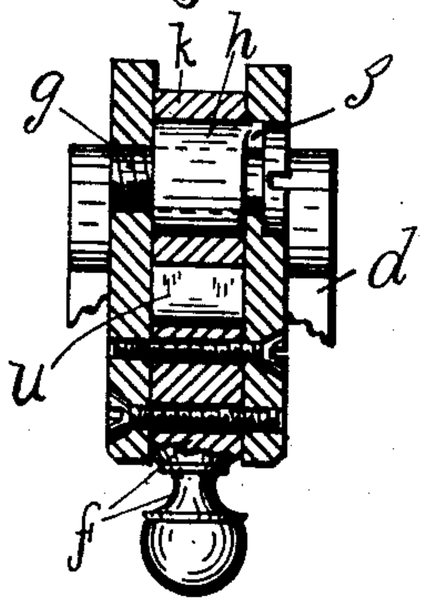


Fig. XI

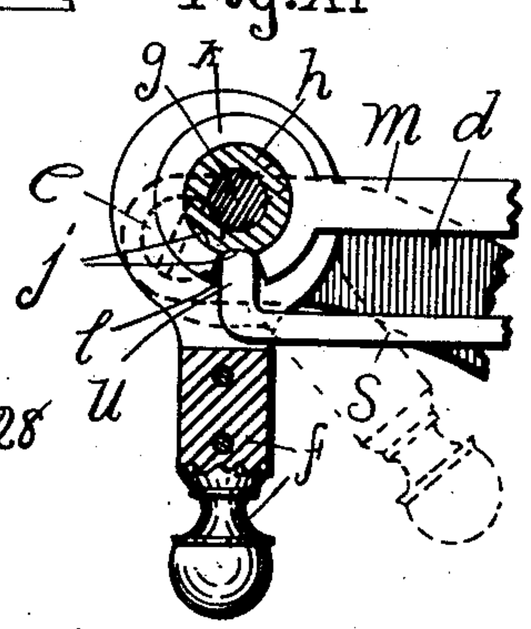
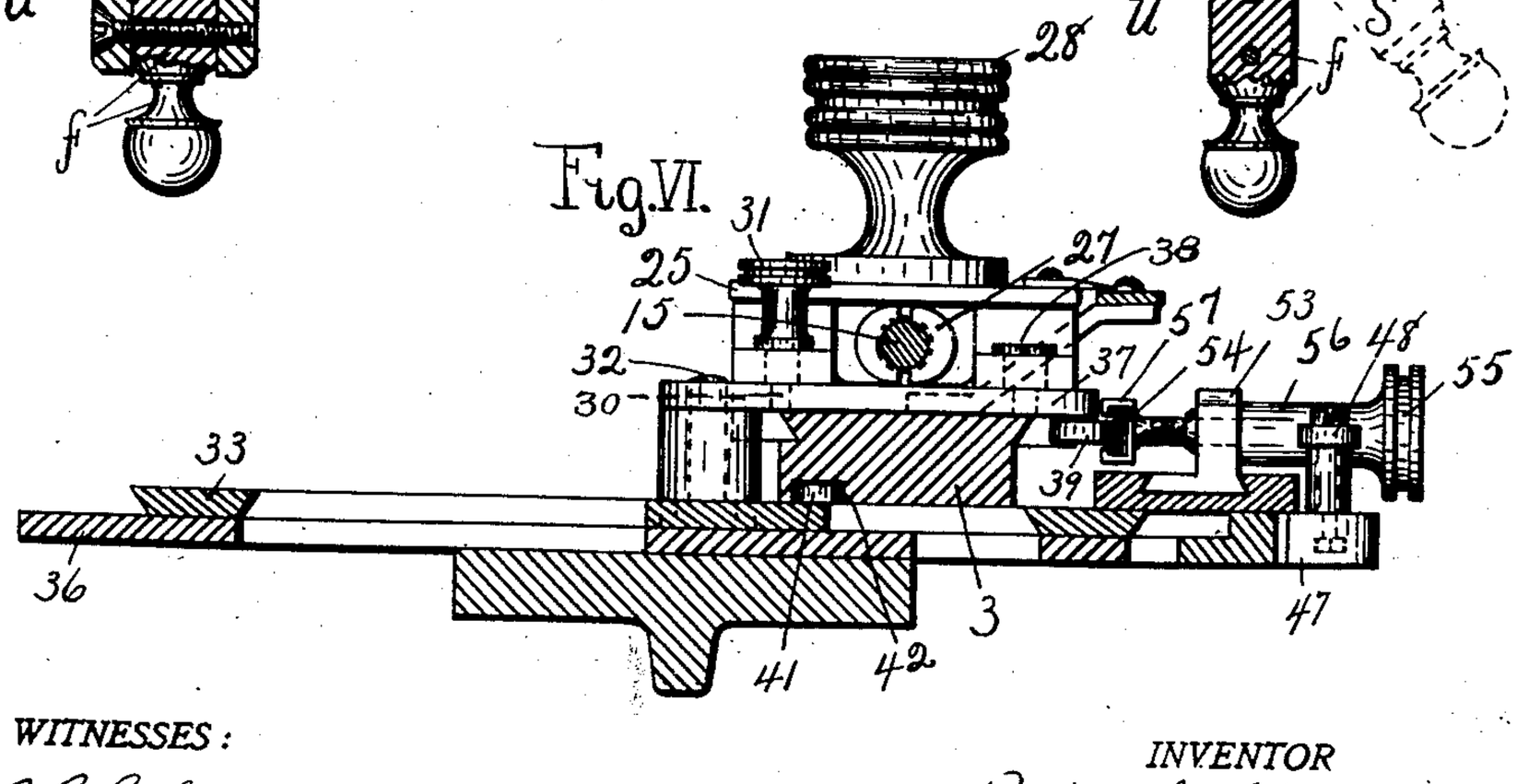


Fig. VI.



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4 SHEETS—SHEET 3.

Fig. III.

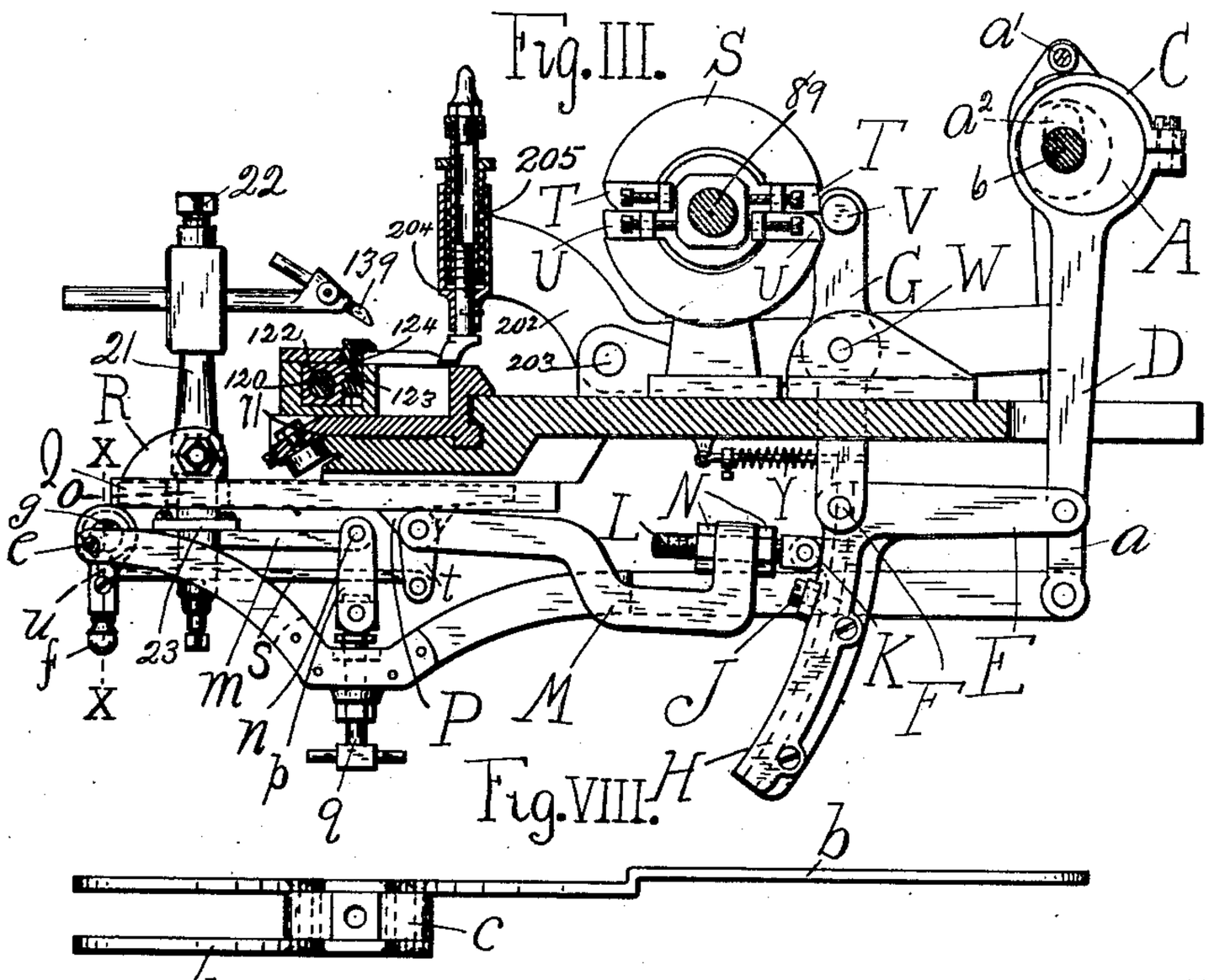


Fig. VIII.

Fig. IV.

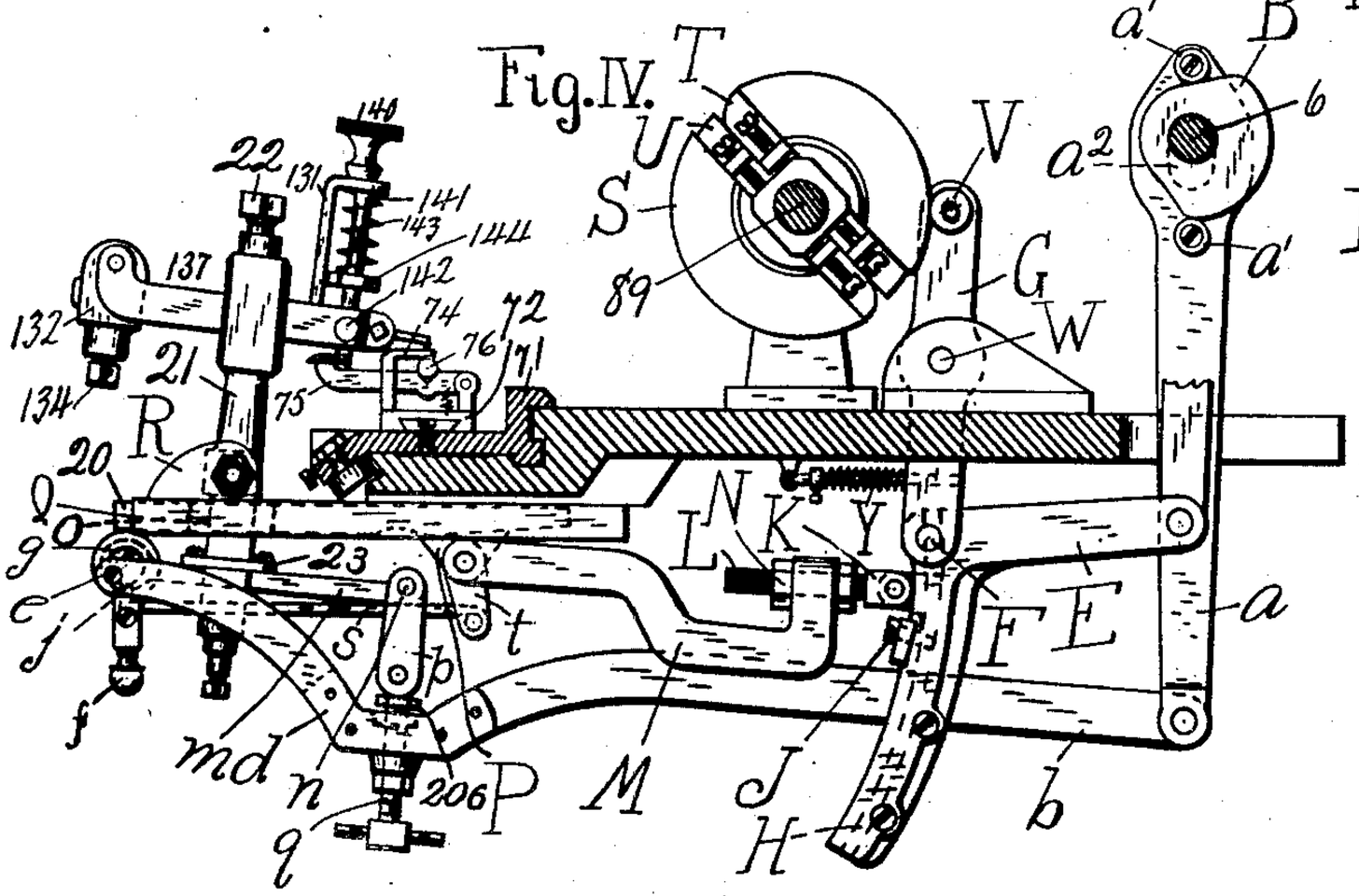
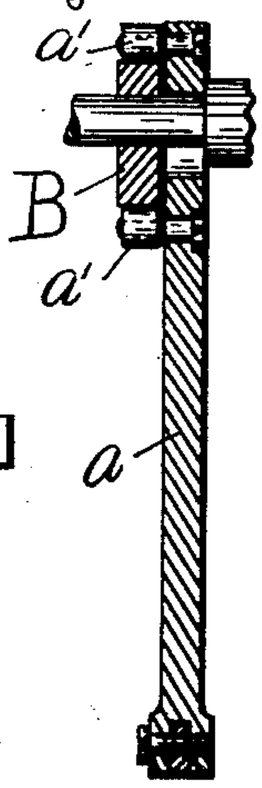


Fig. IX.



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APPLICATION FILED MAY 9, 1902.

921,824. **Patented May 18, 1909.**

4 SHEETS—SHEET 4.

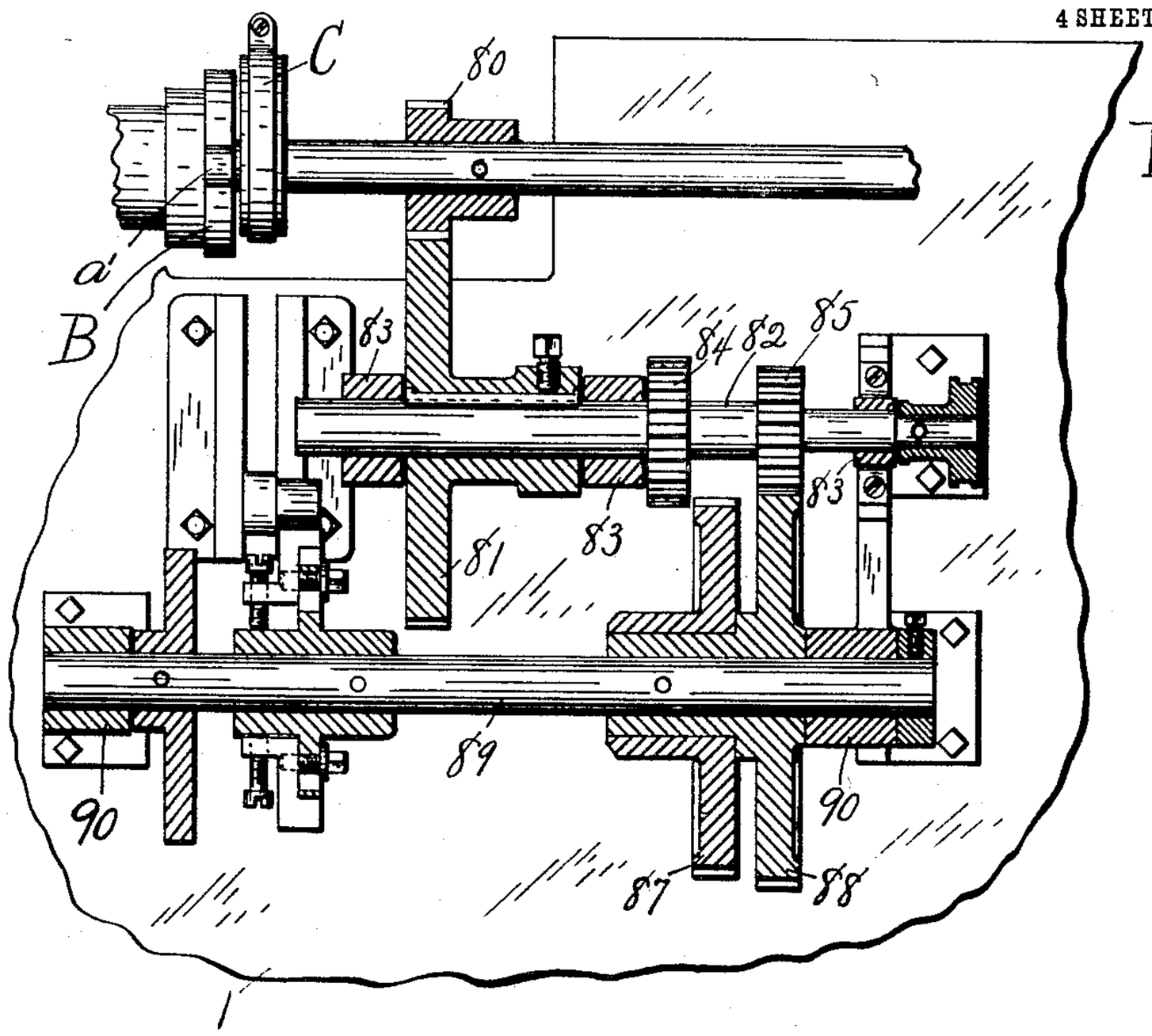


Fig. VII.

Fig. XVII.

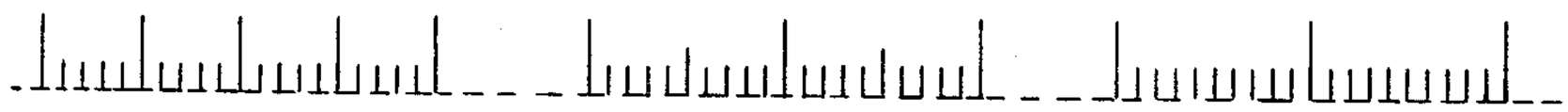
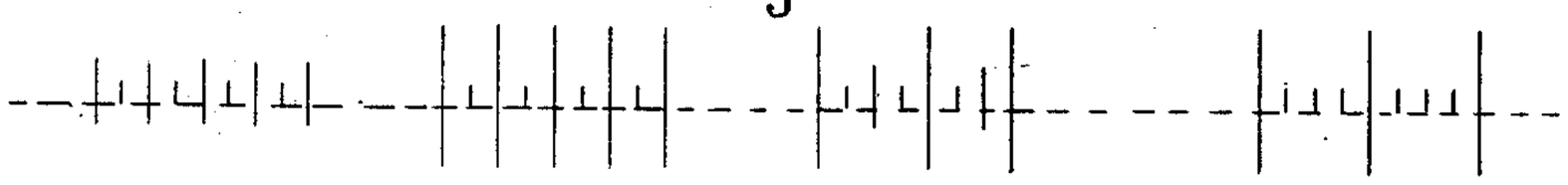


Fig. XVIII.



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ADOLPH GEIGER, OF ROCHESTER, NEW YORK.

GRADUATING-MACHINE.

No. 921,824. Specification of Letters Patent. Patented May 18, 1909.

Application filed May 9, 1902. Serial No. 106,534.

To all whom it may concern:

Be it known that I, ADOLPH GEIGER, of Rochester, in the county of Monroe, in the State of New York, have invented new and useful Improvements in Graduating-Machines, of which the following, taken in connection with the accompanying drawing, is a full, clear, and exact description.

My invention relates to a graduating machine and consists in an essentially new construction and mode of operation which may be adjusted automatically to graduate articles of various forms such as tubular or flat, and of various materials such as glass, composition, wood or metal, with graduation marks of different lengths and arrangement either uniformly spaced, or gradually, or periodically varying.

My invention will be understood by reference to the drawing herewith in which the reference letters and numerals of the specification indicate the same parts in all the figures.

Figure I is a top plan of my machine. Fig. II is an enlarged elevation of the tool holder and adjacent parts, portions being shown in section. Fig. III is a vertical cross section on line III III of Fig. I. Fig. IV is a similar view to Fig. III, showing the parts in another position. Fig. V is a side elevation of the operating screw with the bed plate shown in section. Fig. VI is an enlarged cross section taken on line VI VI of Fig. I. Fig. VII is an enlarged horizontal section of the mechanism by which the graduating marks are regulated. Fig. VIII is an enlarged elevation of the rock arm. Fig. IX is a vertical cross section of the cam lever and cam. Fig. X is an enlarged vertical section on line X X of Fig. III. Fig. XI is a corresponding section at right angles to the preceding. Fig. XII is a plan of the screw extension enlarged. Fig. XIII is an end elevation of the feed carriage. Fig. XIV is a plan of the graduation piece. Fig. XV is a cross section thereof on line XV XV. Fig. XVI is an end elevation of the main carriage. Figs. XVII and XVIII are diagrams illustrating the different styles of graduation that may be effected by my machine.

Base and operating mechanism.—The mechanism is supported on a suitable base or bed-plate 1, provided with track 2 and elevated track or guide-plate 3, arranged at less than a right angle to each other, for the work-carrying carriage and the main carriage respectively. 4 is the main or pulley-shaft, carrying the power pulley and thrown into and out of engagement, by any suitable clutch, having an operating lever 5 with the screw-shaft 6, supported in a suitable bearing and carrying the bevel gear 7 meshing with bevel-gear 8 on the screw-extension 9, in bearing 10 mounted on bed plate 1 as shown in Fig. V and provided with cross pin 11, fitting slots 12 of coupling piece 13, secured by pin 14 to the operating screw 15 supported in bearing 16 and corresponding bearing at other end on guide-plate 3, by which the screw is rotated. Face 17 of coupling-piece is beveled to correspond with the pitch of the screw thread and fit a reverse bevel 18 on a fixed bushing 19, whereby during one half of its revolution, the high point *y* of the coupling-piece rides up the incline 18, forcing the whole screw forward and accelerating the movement of the main carriage connected thereto; while during the other half of the revolution, the high point rides down the incline 18 moving the screw rearwardly, at a speed exactly corresponding to that at which the screw would otherwise tend to move the carriage forward, whereby the main carriage 25 is temporarily stopped during each rotation, and with it the forward movement of the work. The tool carriage and tool are timed to operate on the work, while it is temporarily so stopped. Bushing 19 is a forward bearing of the screw and is adjustably held in position by jam-nuts shown in front and in rear of bearing 16 in Fig. XII.

Main or feed-arm.—Main carriage 25 moving on guide-plate 3 is fitted to the screw 15, by which it is moved forward, and is connected to engage therewith by any suitable means, which may be released when desired. A part 27 having two curved jaws fitting screw 15 and handle 28 for operating same is indicated in Fig. VI, but this is not important as any well known means may be used therefor. At rear end of carriage is fitted to slot 29 a threaded pin shown in dotted lines as lower end of thumb piece 31 in Fig. VI, having thumb-piece 31 and engaging with bell-lever 37 pivoted to carriage at 38, to which is journaled at 32 the semi-circular segment 33 whose function is to carry and guide feed-arm 36, turning on center 32. At opposite end bell-lever has stud or anti-friction roller 39 to follow flexible steel guide-strip. To segment is fitted guide-roller

piece 40 having set-screw 43 and guide roller 41 fitting guide groove 42, in the guide plate 3. (Figs. I and VI.) To segment is also fitted diminishing graduation piece 45, also having set-screw 46 to lock it in position and arm 47 with anti-friction roller 48, to bear against flexible guide strip when in its extended position indicated by dotted lines in Fig. I, and gradually swing the feed-bar to diminish the movement of the work and the size of the graduations as in case of spirit thermometers. When uniform graduation is desired thumb-piece 31 is tightened preventing swing of pin 30 in slot 29; set-screw 46 of diminishing piece 45 is loosened, and guide-roller-piece 40 is fixed on the segment to guide the feed-arm straight by engagement of roller 41 in groove 42. By loosening thumb-piece 31 and also set-screw 43, the forward movement of feed-arm may be guided (and varied) to effect graduations of varying size according to position of various parts of flexible guide-strip, adjusted according to three or more test points, the guide-strip being parallel to screw, in normal position as shown in full lines Fig. I. The combination of gradually diminishing graduation, and variation in adjacent graduations according to test points is effected by tightening set-screw 46 to lock diminishing-piece on segment, when it acts as a guide, its roller 48 following flexible guide-strip in its extended, dotted line position.

The flexible guide strip.—On one side, the frame is provided with slotted arms 50 50 on which is adjustably sustained b y the screws 51 51 the supporting plate 52, provided with bearings 53, on a dove tailed plate in which are sustained the two part carrying screws, carrying the guide strip 54 composed of several thin plates of steel to afford sufficient flexibility. These carrying screws are composed of handle 55, shank 56 and a screw fitting into the shank and provided with the integral fork 57 for receiving and sustaining the flexible guide plate 54 and affording a space for the roller 37 or 48 to bear on the guide bar between the ends of these forks, so that by turning the handle the fork and guide plate are moved in and out. When the supporting arm 52, and the flexible guide plate are in normal position as shown in Fig. I, the variation effected by the flexible guide plate is proportioned to smaller graduations, but when they are swung out more or less into position inclined to the direction of screw 15 the variation is greater and effects graduations at first of larger and of gradually diminishing size. There are several of these carrying screws, as here shown, in order to adjust the flexible guide strip at various points independently, according to the test points.

Work-carrying carriage.—This is composed of the feed carriage and the work carriage, essentially one carriage, but separated and adjustably connected, for simplicity in construction and convenience in adjustment and operation. 60 is the feed carriage fitted to track 2 preferably arranged at 45° to elevated guide plate 3 and bent downwardly as best shown in Fig. V to afford sufficient room for the passage of work of large size, so that a thermometer, or other instrument of considerable length and diameter, may be graduated by my mechanism as well as a smaller instrument. This feed carriage is of the peculiar form here shown (Fig. XIII) for the same purpose; it is composed of a base 62 having a tongue 63 fitting a groove in the frame, and on the opposite side an inclined flange 64 carrying one or more inclined anti-friction rollers 65, by which this carriage is secured in position on the slide; 66 is its post or upright, and 67 its top plate, affording a rest for the feed-arm and carrying the stud or anti-friction roller 68 held in constant engagement with that arm by weight 69, fastened to the feed carriage by a cord passing over a guide pulley as shown in Fig. I, or by other suitable means. The feed motion of the feed carriage and the work carriage is effected by feed-arm engaging with this projecting roller. The greatest movement of the work is effected when the feed-arm is swung back as far as possible (to the left in Fig. I), making a smaller angle with arm and track; when it is turned forward the motion diminishes. In Fig. I is shown a position for a considerable speed of work-carrying carriage, it not being possible to swing the feed-arm much farther out than here shown, without binding the parts. By any suitable connection, such as rod 70 adjustable in and out of feed carriage 60, the feed carriage is connected to the work carriage 71 moving the work past the tool, arranged to operate at right angles thereto and by an eccentric and its connections; the work is temporarily held motionless during the operation of the tool, by the means heretofore described, and the tool after each cut or operation is rocked clear from the moving work by means to be described. To work carriage is fitted plate 72 adjustable by screw 73 and carrying two or more clamps 74 and notched spring-levers 75, by which work 76, such as thermometer tubes of wide range as to length and diameter, may be held firmly in position (Figs. I and IV).

The eccentric and its connections to the tool carriage.—On the main shaft 4 is adjustably secured the eccentric A by which the tool is moved across the advancing work to make the cut; there is also secured thereon the cam B, whose function of rocking the tool into and out of operation will hereinafter be described. First of the eccentric—to this, by collar C of usual construction, is secured the

eccentric rod D pivotally connected to one arm of bell-crank or connecting lever E, which is journaled at F to the lower end of the cut-length lever G, controlling with cam-wheel the length of mark. On a guide way H in the lower arm of the bell-crank is adjustably secured by set screw J the connecting rod to the tool carriage; K is the block fitting the guide way, to which is journaled the screw-stem L of the connecting arm, adjustably connected to the bar-element M of the rod by suitable nuts N, to adjust the position of the tool carriage and tool according to the size and position of the work. The bar M is connected to an ear P on the tool carriage 20 fitted to slides Q Q bolted to the frame or base, and extending at right angles therefrom.

Q Q are ordinary grooved bars, supporting the carriers 20 formed with ribs to fit the grooves. Between ears R R on the tool carriage is journaled the tool post 21, depending through slot O in the carriage, and to the upper end of which is secured the tool of a form suitable, either for metal or for glass work, as hereinafter described, by set screw 22. This post is provided with integral flange 23, which is bolted to the rocking piece now to be described, by which, through the operation of cam B the tool is rocked into and out of operative position at each rotation of the main shaft.

Tool-post rocking mechanism.—Cam B, all of whose diameters are equal, engages with rollers a' a' to operate cam-rod a, slotted at a^2, and is pivotally connected to the inner end of a single rock-arm b, carrying toward its forward end the block c to the opposite side of which is fixed the parallel fork-piece d, exactly corresponding to the front end of the rock-arm; the ends of the rock-arm and fork-piece are connected by bolts e e, on which is journaled handle f, whose forked upper ends are connected by bolt g, on which is fitted the bushing h, preferably of tool steel, having two notches j·j at 50° more or less, and locked to the handle by stud z, engaging in a suitable notch. To this bushing is fitted the collar k, (having a longer notch l), of the rocking piece m, pivotally connected at its opposite end n to the hanger p and intermediately bolted to flanges 23 23 of the tool post through which or around which it passes. To regulate the depth of the mark or cut, the end of rocking piece m is elevated and depressed by adjusting screw q, fitted to turn in a block c and locked in position therein by suitable lock-nuts. Hanger or link p is connected to rocking piece at n and is provided at its lower end with head 206, with which head adjusting screw q is fitted to engage.

Spring s on arm t of tool carriage extends through aperture in tool-post and is provided with a nose u extending through notch l in collar k, to engage with one of the notches j in the bushing h to lock tool-post in operative or non-operative position. As the handle f is turned from one position to the other, the tool is thrown into operative position, or thrown out of position and clear of the work, it being rocked at each stroke away from the work after the cut has been made. In Fig. III these parts are shown in position ready to operate; in Fig. IV tool carriage is drawn forward and tool rocked to make the mark; in Fig. XI, full lines indicate operative, dotted lines non-operative position. Figs. II and X are also enlarged details of rocking mechanism; Figs. VIII and IX detached parts. In Fig. III is shown in section a plunger depressed by a spring to assist in holding the work while being marked.

Mechanism regulating length of graduation marks.—On main shaft 4 is keyed pinion 80 meshing with gear 81 keyed on shifting counter-shaft 82, suitably journaled in bearings 83 83; this gear 81 is preferably fitted between two of the bearings 83 83 and connected to the counter-shaft by feather and spline, to maintain a constant position while the shaft is being shifted. On this counter-shaft are keyed pinions 84 and 85 of different size, and on one end a grooved shifting pulley. In the first position of this shaft here illustrated, the pinion 85 meshes with the larger gear 88 on cam-wheel shaft 89, also supported in suitable bearings 90 90. In the second position the larger pinion 84 meshes with the smaller gear 87 of this cam-wheel shaft 89. (See Figs. I and VII). These gears and pinions are so proportioned that in the first position main shaft 4 rotates ten times while cam-wheel shaft 89 is rotating once, and in the second position main shaft rotates four times to once of the cam-wheel shaft, by which the following result is accomplished:

On cam-wheel shaft 89 is keyed the cam wheel S provided with opposite pairs of adjustable cams T T and U U, the detailed construction and arrangement of these cams is best shown in Figs. III, IV, VII; in the present arrangement adapted to be used for graduating metal articles, the cams T T are adapted to be adjusted inwardly within the periphery of the roller, and the cams U U at any distance from flush with the periphery outwardly, and while the roller is rotating these engage with the projecting stud V on the upper arm of the cut-length lever G fulcrumed at W, whereby the projecting cam forces the upper end of said lever G inwardly, its lower end carrying the bell crank outwardly, and the mark made by the tool on that stroke is longer on one side of the axis of the work and scale; the reverse is effected by the depressed cams, the roller V being held in engagement therewith by the compression spring Y. Cams T and U are adjusted and clamped on their wheel S by set

screws and clamping screws as clearly shown in Fig. VII. Figs. XVI and XVII illustrate the operation of these parts, by which graduation marks of different lengths and arrangement, and on one or both sides of the axis, are produced. In XVI are shown varieties of graduation produced with counter-shaft in first position and by adjustment only of cams T T. By arranging cams T T flush and cams U U outwardly, the marks would be made on the other side of the axis.

The styles of graduation shown in Fig. XVII are produced by arranging shifting shaft in second position, and both cams U U outwardly and cams T T inwardly. It will be noticed that the cams of each pair may be differently adjusted. The actual size and variations in size of the spaces are effected by the flexible guide-plate and feed arm—swung out, this effects high speed and large graduations, swung in, low speed and small graduations.

Tool holder.—In Figs. III and IV tool-holders are sufficiently indicated to show their position. These tool-holders will be the subject of other applications. In Fig. III a screw 120, in bearings, has right and left hand threads engaging with blocks 122 having projections 123 fitting grooves 124 in the face of the work, so that by turning a knob on the end of the screw in one direction, the work is clamped in place, and by turning in the other, the work is released. Arm 202, pivotally supported at 203, carries a plunger 204 held down by spring 205, whereby the work, such as a flat ruler, is held down yieldingly while being marked. After marking the tool-holder may be swung back on the pivot. In Fig. IV is shown supported on tool-post 21 the spring arm 131 having the bearing 132 secured in place by set-screw 134. In said spring arm is adjustably supported the rod 141 by thumb-piece 140 and spring 143 arranged between the arm 131 and the nut 144, and connected to the fork 137 by pin 142. The tool is carried in a suitable clamp in the front end of the fork, and by the parts just described is supported to bear on the work with a delicate resilient pressure.

Operation.—To start the machine as for the graduation of a thermometer tube according to Fahrenheit scale in which two test points are fixed, namely, the freezing point and the boiling point—releasing the split nut 27, move the main carriage with the feed arm and also the feed carriage until the center of the feed arm is over the center of the feed carriage roller, that is, until point 32 is over the center of roller 68. When thus centered the pointer 150 on the main carriage should point to 32 on a stationary scale 151 (Fig. I) suitably supported on the machine frame in front of and parallel to the screw (— will be to the right and + to the left). Then adjust the thermometer tube to be graduated in such position that the point of the tool stands exactly over the first test point near the top of the tube. Then move the main carriage back the number of degrees on the scale corresponding to the number of graduations on the tube between the first test point and the next. In this case it will be 180° on the scale or 180 threads on the screw to degree 212 on the scale 151. The feed carriage will follow bringing the second test point toward the tool, but not coinciding therewith. Then loosen clamping screw on the segment, that is, set screw 43, and swing the feed arm moving the feed carriage until the second test point exactly coincides with the tool. In this position, tighten set screw 43 and start the machine. If there are several test points, of course use the flexible guide strip supported on several carrying screws, one corresponding to each test point, and clamp the segment by means of set screw 46.

Having thus described my invention what I claim and desire to protect by Letters Patent is:

1. In combination in a graduating machine, a suitable base, tracks thereon for the main carriage and the work-carrying carriage respectively, arranged at an angle to each other, the main carriage, an arm on the main carriage, the work carrying carriage engaging with said arm, means for securing the work on its carriage, the tool and means for moving the tool across the work.

2. In combination in a graduating machine, a base, tracks thereon arranged at an angle, the main carriage and the work-carrying carriage fitted to the respective tracks, a connection between the carriages, means for varying the position of said connection, while the main carriage is moving, a tool support, means for reciprocating the tool across the work, means for rocking the tool support, means for moving the main carriage, and means for varying periodically the reciprocation of the tool to control the length and position of the graduation marks.

3. In combination in a graduating machine, a supporting base, a guide plate and a track on the base, arranged at less than a right angle to each other, a main carriage on the guide plate, and means for moving it longitudinally thereon, an adjustable feed-arm on the main carriage and engaging with a work-carrying carriage, the elongated work-carrying carriage fitted to the track and moved longitudinally thereon by the movement of the feed-arm, a tool-carriage carrying the tool fitted to the base, and means for reciprocating the tool carriage at an angle to the work to make the graduation marks.

4. In combination in a graduating machine, a supporting base, a guide-plate and a track on the base arranged at less than a right

angle to each other, a main carriage fitting the guide-plate and means for moving it forward thereon, an adjustable feed-arm secured to the main carriage and engaging with a work-carrying carriage, an elongated work-carrying carriage fitted to the track and moved forward thereon by the movement of the feed-arm, a tool carriage carrying the graduating tool fitted to move on the base, means for moving the tool carriage at right angles to the work-carrying carriage to move the tool across the work and make the graduation marks, and means for rocking the tool out of the path of the work on the return stroke.

5. In combination in a graduating machine, a supporting base, guide-ways thereon for the main carriage and the work-carrying carriage respectively, a screw supported in suitable bearings, a main carriage fitted to its guide-way, and means for engaging it with the screw, an adjustable feed-arm supported on the main carriage and engaging with a work-carrying carriage, the work-carrying carriage fitted to its guide-way, a tool carriage and a tool, means for reciprocating the tool carriage periodically substantially at right angles to the work-carrying carriage, and means for rotating the screw.

6. In combination in a graduating machine, a supporting base, a guide-plate for the main carriage, and a slide-way for the work-carrying carriage supported thereon at less than a right angle to each other; a screw supported in bearings parallel to the guide-plate, a main carriage fitted to the guide-plate, means for connecting the carriage to the screw to be moved forward thereby, a feed-arm rotatably adjustable on the carriage, and means for fixing it in position; the work-carrying carriage fitted to the slide-way and engaging with the feed-arm to be moved forward thereby; means for clamping the work on the work-carrying carriage, supports for the tool carriage, the tool carriage, carrying the tool, fitted thereto; means for rotating the screw to move forward the feed-arm and work, means for moving the tool carriage across the work to make the graduation marks, and means for rocking the tool out of the path of the work on the return stroke.

7. In combination in a graduating machine, a base, an elevated guide-plate secured thereto, a depressed slide-way arranged thereon at less than a right angle thereto, an operating screw carried in journals on the guide-plate and parallel thereto, a main carriage fitted to the guide-plate formed with an aperture for the passage of the screw and with means for engaging it therewith, a feed-arm adjustably carried on the main carriage; a feed-carriage and a work-carriage fitted to move on the slide-way, means for connecting the two latter carriages, a tool carriage guide-way supported on the base adjacent to the slide-way, a tool-carriage carrying the tool fitted thereto, means for reciprocating the tool across the work to make the graduation marks, and means for rocking the tool out of the path of the work on the return stroke.

8. In a graduating machine, feed-arm mechanism to move the work having in combination a suitable base, a guide-plate secured thereon, a screw journaled on the guide-plate and parallel thereto, a carriage fitted to move on the guide-plate and means for throwing it into engagement with the screw to be moved thereby; a segment journaled on the carriage and adjustable in a horizontal plane, a feed-arm integral with the segment, a guide roller piece adjustably secured on the segment and provided with a roller to engage in a longitudinal slot in the guide-plate, means for fixing the guide roller piece in position; a diminishing graduation piece adjustable on the segment having one end adapted to engage with the flexible guide-strip, means for fixing the diminishing graduation piece in position on the segment; a supporting-plate adjustably supported on the base adjacent to the guide-plate, means for adjusting said supporting-plate angularly with relation to the screw, a flexible guide-strip supported thereon; adjusting screws carrying said guide-strip and adapted to adjust different points thereof according to test points.

9. In a graduating machine, a tool carriage mechanism for operating the tool-carriage substantially at a right angle to the path of the work to make the graduation marks having in combination a shaft, an eccentric thereon, an eccentric rod provided with a collar fitted to the eccentric, a bell-crank suitably journaled having one arm connected to said eccentric rod, and a connecting-rod adjustably connected to the tool-carriage and to the other arm of said bell-crank.

10. In a graduating machine, a tool carriage mechanism for operating the tool-carriage substantially at right angles to the path of the work to make the graduation marks having in combination a shaft, an eccentric thereon, a collar fitted thereto, an eccentric rod secured to the collar, a bell-crank suitably journaled connected to said rod by one arm and having a guide-way formed in its opposite arm, a block fitted to said guide-way and adjustable therein, and a connecting-rod of variable length connected to said block and to the tool carriage.

11. In a graduating machine, mechanism for supporting and operating the graduating tool having in combination the base, suitable guides thereon arranged substantially at right angles to the path of the work, a tool carriage fitted to said guides, a tool post pivotally supported between ears on the carriage having an upwardly extending post

provided with set-screws for the tool, and a lower portion downwardly depending through a slot in the carriage, a shaft, an eccentric thereon, a collar and integral eccentric rod fitted to the eccentric, a bell-crank journaled to one end of a cut-length lever and having one arm connected to the eccentric lever, and its other arm formed with a slide-way, a block adjustable in said slide-way, and having a set-screw, a connecting-rod of adjustable length connected to the block and to the tool carriage.

12. In a graduating machine, mechanism for operating the tool-carriage substantially at right angles to the work to mark the graduations, having in combination a main shaft, an eccentric thereon, an eccentric rod operated thereby, a bell-crank suitably journaled having one arm connected to said eccentric rod, a tool-carriage suitably supported, and a connecting arm connecting the tool-carriage to the opposite arm of the bell-crank, a cam-wheel shaft, a cam-wheel thereon having cams radially adjustable, said cam-wheel being supported to swing the bell-crank and to control the extent of the movement of the tool-carriage, connections between main shaft and cam-wheel shaft, and means for rotating main shaft.

13. In a graduating machine, mechanism for supporting and operating the graduating tool having in combination the base, suitable guides thereon arranged substantially at right angles to the path of the work; a tool-carriage fitted to said guides, a tool-post pivotally supported between ears on the carriage having an upwardly extending portion provided with set-screws for the tool, and a lower portion downwardly depending through a slot in the carriage; a main shaft, an eccentric thereon, a collar and an integral eccentric rod fitted to the eccentric; a bell-crank journaled to one end of a cut-length lever and having one arm connected to the eccentric rod and its other arm formed with a slide-way, a block adjustable in said slide-way and having a screw-stem fitted thereto, a connecting-bar attached to the work-carriage and adjustably connected to said screw-stem; a cam-wheel shaft, a cam-wheel thereon, slots in said cam-wheel and cams radially adjustable therein; the cut-length lever journaled and carrying the bell-crank, means for holding said cut-length lever in engagement with said cam-wheel and cams, connections between main shaft and cam-wheel shaft, and means for operating main shaft.

14. In a graduating machine, mechanism for operating the tool-carriage and the tool, having in combination a main shaft, an eccentric thereon, an eccentric rod operated thereby, a suitably journaled bell-crank having its upper arm connected to said eccentric rod, and its lower arm connected by connecting arm to the tool-carriage, a cam-wheel shaft, a cam-wheel thereon carrying radially adjustable cams, intermediate mechanism for controlling bell-crank by its periphery and cams, and means for varying the rotation of the cam-wheel shaft with reference to the main shaft to control the length and position of the graduation marks.

15. In a graduating machine, mechanism for operating the tool-carriage having in combination a main shaft, an eccentric thereon, an eccentric rod arm having a collar fitted to the eccentric, a cut-length lever suitably journaled, a bell-crank journaled on said cut-length lever and having one arm connected to the eccentric rod, a connecting-rod connecting the other arm of the bell-crank to the tool carriage, a counter-shaft connected to the main shaft, pinions of varying sizes thereon, means for shifting one pinion or the other into engagement with its corresponding gear to control the rotation of the cam-wheel, said cam-wheel on the cam shaft in peripheral engagement with the cut-length lever, and cams radially adjustable on said cam-wheel to vary the movement of the tool-carriage and the length of the graduation marks.

16. In a graduating machine, mechanism for operating the tool-carriage having in combination a main shaft, an eccentric thereon, an eccentric rod having an integral collar fitting the eccentric; a cut-length lever suitably journaled, a bell-crank journaled on the lower end of the cut-length lever and having its upper arm connected to the eccentric rod; the tool-carriage suitably supported; a connecting-rod connecting the tool-carriage to the lower arm of the bell-crank; a counter-shaft parallel to the main shaft, means for rotating the main shaft, gears connecting it to the counter-shaft; pinions of varying size adjustably carried on the counter-shaft, a cam-wheel shaft parallel to the counter-shaft, gears of varying size on the counter-shaft reversely arranged with reference to said pinions with which they are respectively adapted to engage; a cam-wheel on the cam-wheel shaft, cams radially adjustable on the cam-wheel to engage with the upper end of the cut-length lever periodically to control the length and position of the graduation marks.

17. In a graduating machine, mechanism for rocking the tool-post periodically to move the tool out of the path of the work, having in combination a main shaft, a cam thereon, means for rotating the shaft, a cam rod controlled by the cam, a rock-arm pivotally connected to said cam rod, a rocking-piece at one end pivotally connected to the rock-arm and at its opposite end adjustably supported on the rock-arm, the tool-carriage suitably supported, and the tool-post pivotally supported on the tool-carriage and connected to the rocking-piece between its ends.

18. In a graduating machine, mechanism

for rocking the tool-post periodically to move the tool out of the path of the work having in combination a main shaft, a cam thereon, a cam rod elevated and depressed by said cam, a rock-arm pivotally connected to the lower end of the cam rod and having a forked end, an intermediate block on said rock-arm, an adjustable screw in said block, a handle journaled in the forked end of the rock-arm having the side-plates of its upper forked end connected by a bolt, notched bushing on the bolt, a rocking-piece pivotally connected at its rear end to a hanger, said hanger being elevated and depressed by the adjustable screw, and the rocking-piece provided with an integral collar fitting said bushing and having an elongated notch, a spring connected to the tool-carriage and having a nose extending through said elongated notch to engage with one of the bushing notches, the tool-carriage suitably supported and having a central opening, the tool-post pivotally supported between ears on said tool-carriage and having a lower end depending through said opening, and means for connecting said lower end to the middle portion of the rocking-piece.

19. In a graduating machine, mechanism for regulating the length and position of the graduating marks having in combination a base, a tool carriage slidably arranged thereon, a tool holder pivotally carried on the tool carriage, a main shaft, connections between the main shaft and the tool carriage to reciprocate the carriage, of means intermediately arranged to periodically give an accelerating movement to the carriage, both forwardly and rearwardly, means for timing said accelerating movement, a tool in the tool-holder, and means to rock the tool into and out of engagement with the stock.

20. In a graduating machine, mechanism for regulating the length and position of graduation marks, having in combination, a main shaft, a cam wheel shaft, connections between said shafts, a cam-wheel on the cam-shaft, adjustable cams on the cam-wheel, means to secure the cams in adjustable position, a tool-carriage, a tool holder, pivotally carried on the tool-carriage, a cut-length lever suitably supported, a bell crank hung on one arm of said cut-length-lever, a roller on the other arm, said roller engaging the cams, connections between the bell-crank and the tool-holder, connections between the bell-crank and the main shaft whereby the bell-crank is rocked, a spring suitably arranged to hold the rock-lever in engagement with the cams.

21. In a graduating machine having in combination, a base, a work carriage arranged on the base, means for advancing the carriage periodically, means for governing the distance of each advance movement, means for securing the work on the work carriage, a tool carriage at right angles to the work-carriage, a tool carried on the tool-carriage, means to oscillate the tool-carriage, means for regulating said oscillations, means to rock the tool out of engagement with the work on the return stroke and means to throw the tool in and out of operative position.

22. In a graduating machine means for operating the feed arm having in combination a suitable base, a guide plate, an elongated operating screw journaled thereon, a coupling piece secured to the screw at one end and having a beveled face, a fixed nut, suitably arranged, having a reversely beveled face adapted to engage with the coupling piece during the rotation of the screw, means for rotating the coupling piece, a main carriage fitted to the guide plate and to the screw, means for securing the carriage to the screw to be operated thereby, a bell-crank-lever journaled on the carriage, a segment pivoted on one arm of the bell-lever, an elongated feed-arm integral with the segment, a flexible guide-strip, a roller on the bell-crank engaging the guide strip, means to secure the bell-lever to the carriage, integral slotted arms on one side of the frame, a supporting plate adjustably secured thereto, integral bearings on this supporting plate, and adjustable guide strip supports carried in the bearings.

In testimony whereof, I have hereunto signed my name.

ADOLPH GEIGER. [L. S.]

Witnesses:
C. C. SCHOENECK,
ALFRED WILKINSON.