No. 652,592. Patented June 26, 1900.

D. H. CHURCH.

MACHINE FOR TAPERING STEADY PINS.

(Application filed May 5, 1898.)

(No Model.) 6 Sheets—Sheet 1.

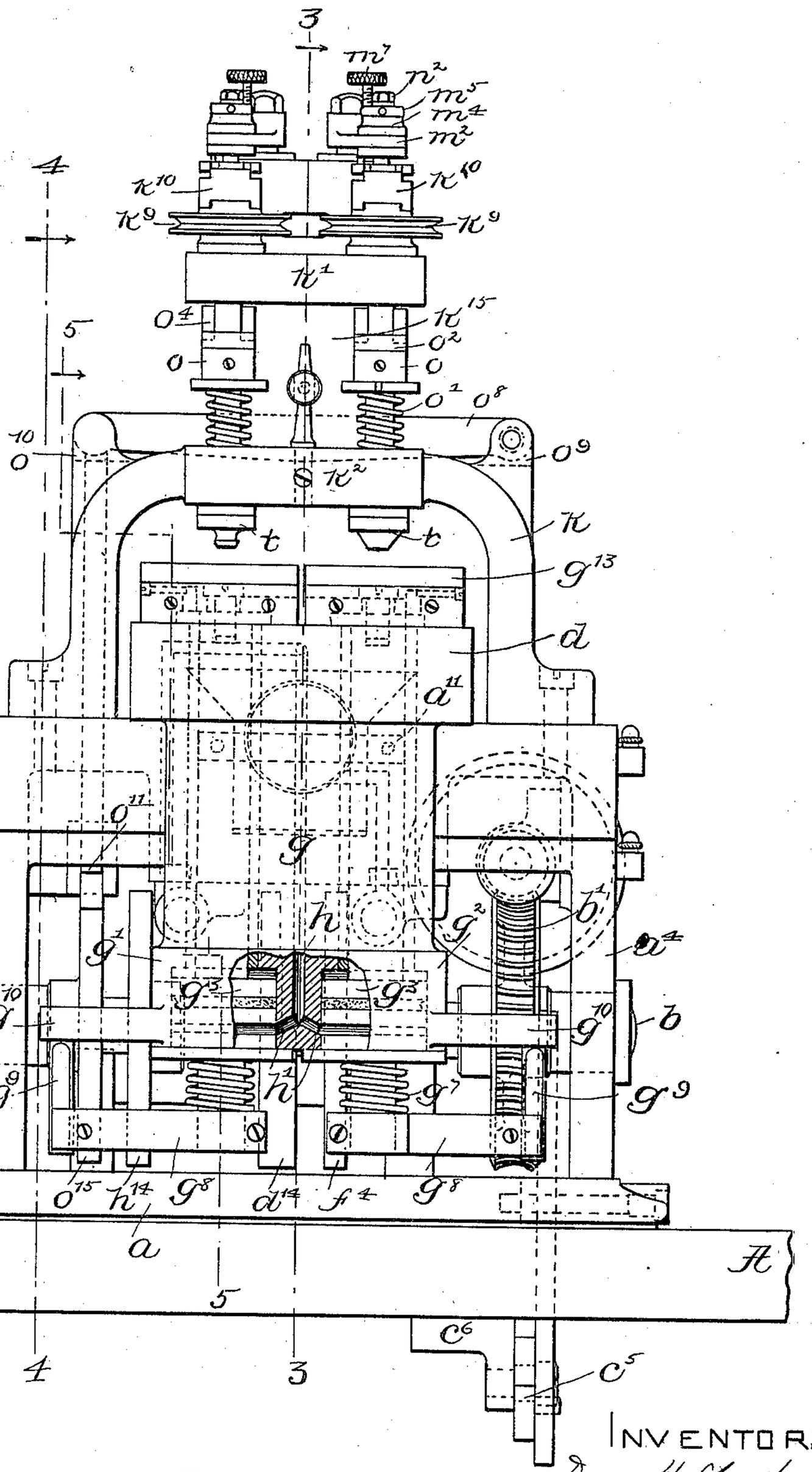

FIG. 1.

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A. D. Harman
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(No Model.) 6 Sheets—Sheet 2.

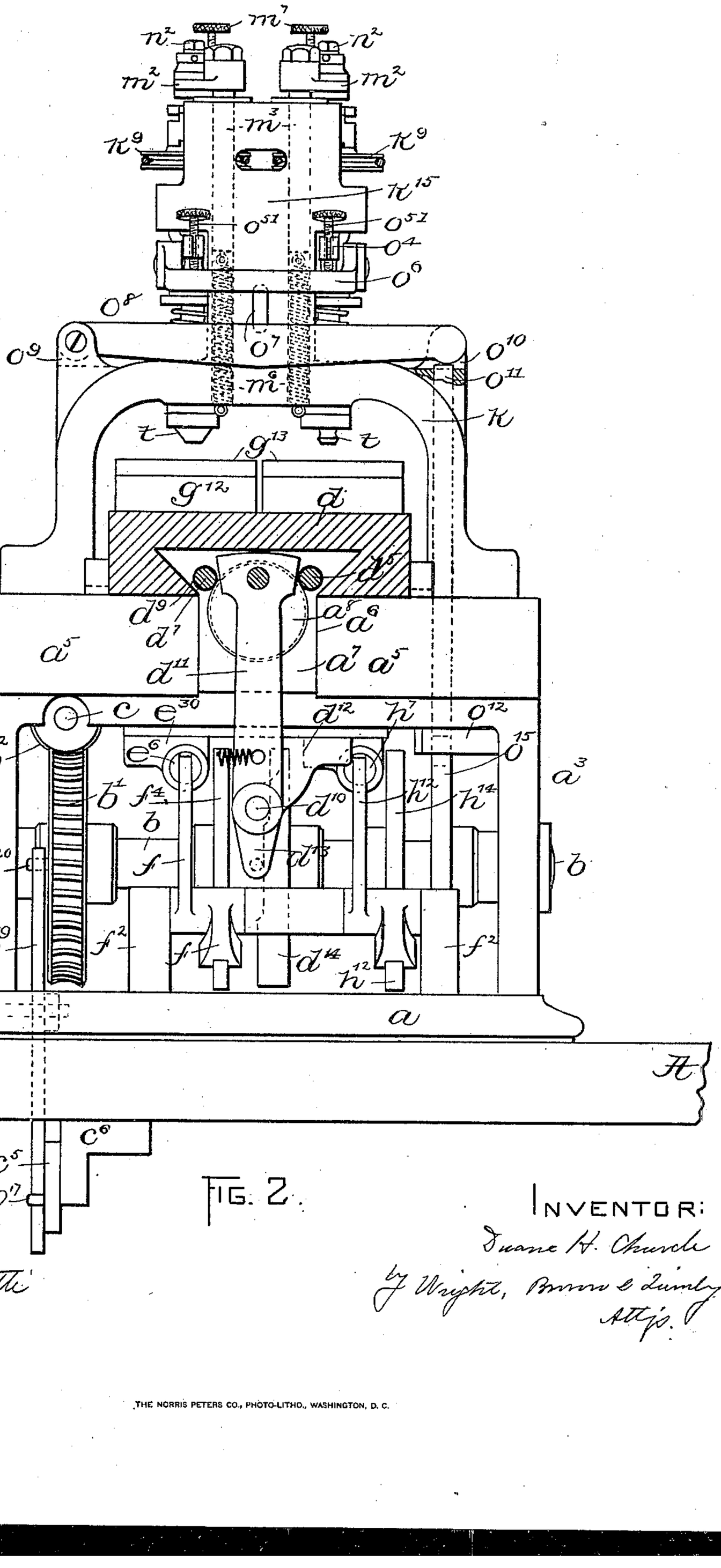

FIG. 2.

WITNESSES:
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(Application filed May 5, 1898.)

(No Model.)

6 Sheets—Sheet 3.

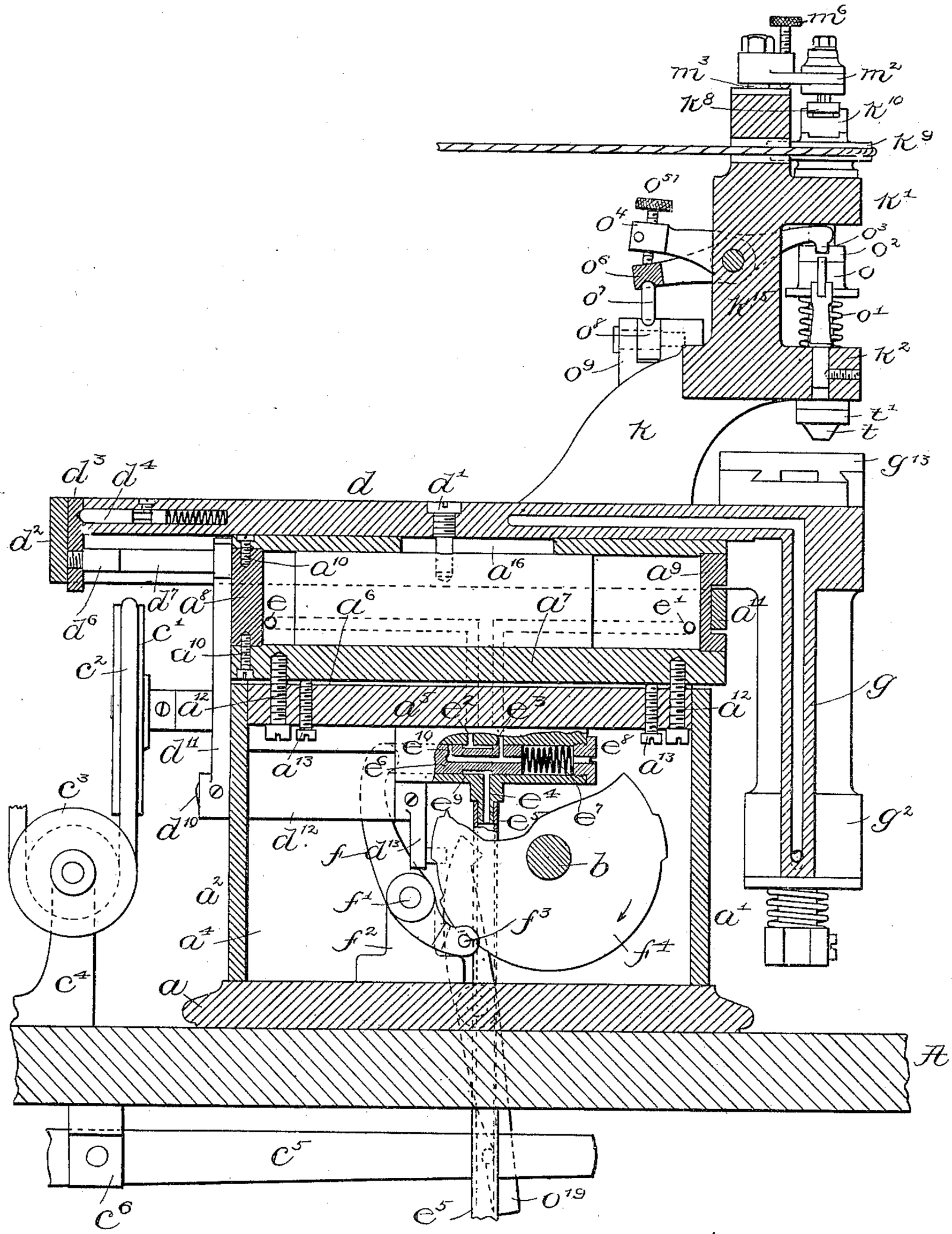

FIG. 3.

WITNESSES:
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MACHINE FOR TAPERING STEADY PINS.

(Application filed May 5, 1898.)

(No Model.) 6 Sheets—Sheet 4.

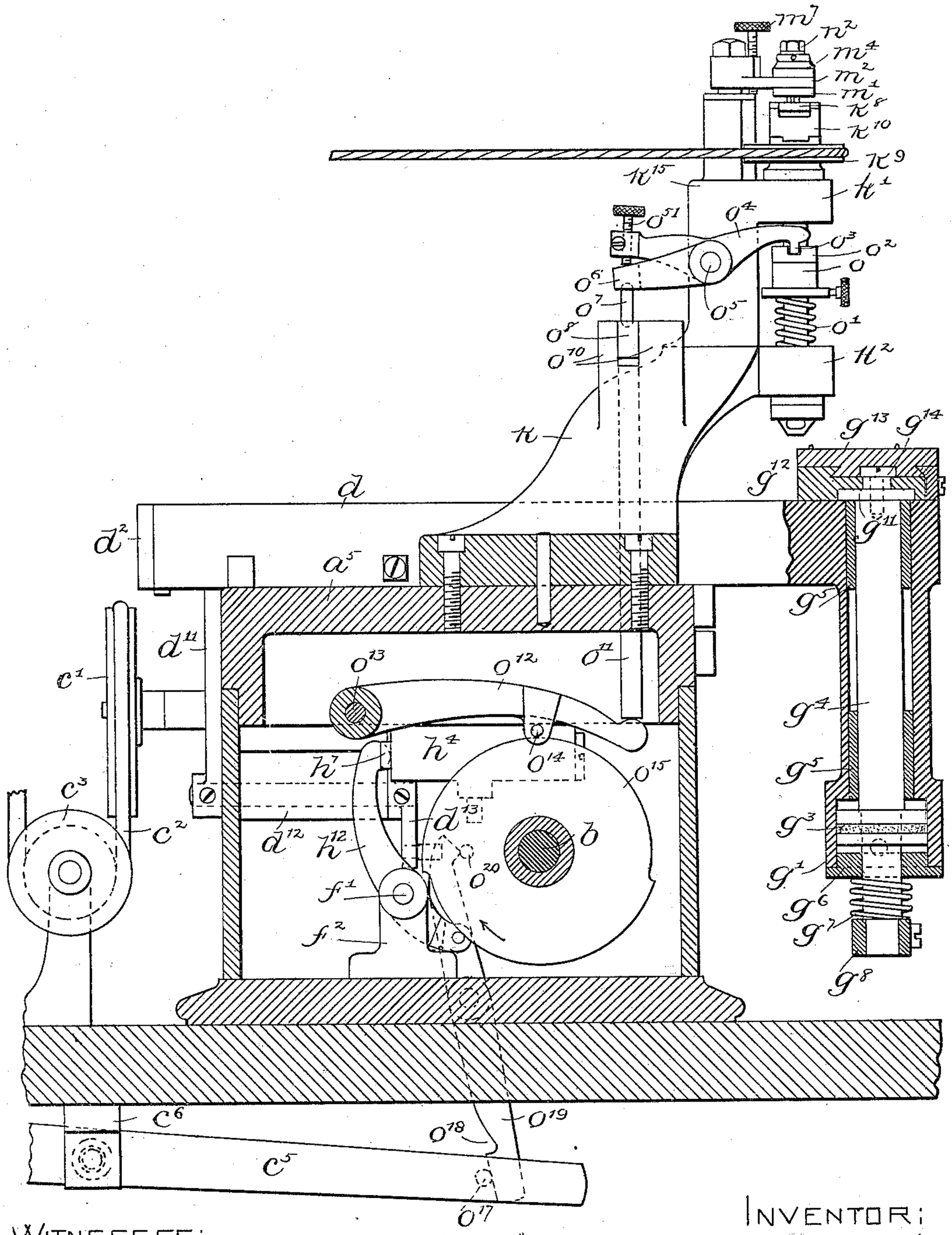

FIG. 4.

WITNESSES:
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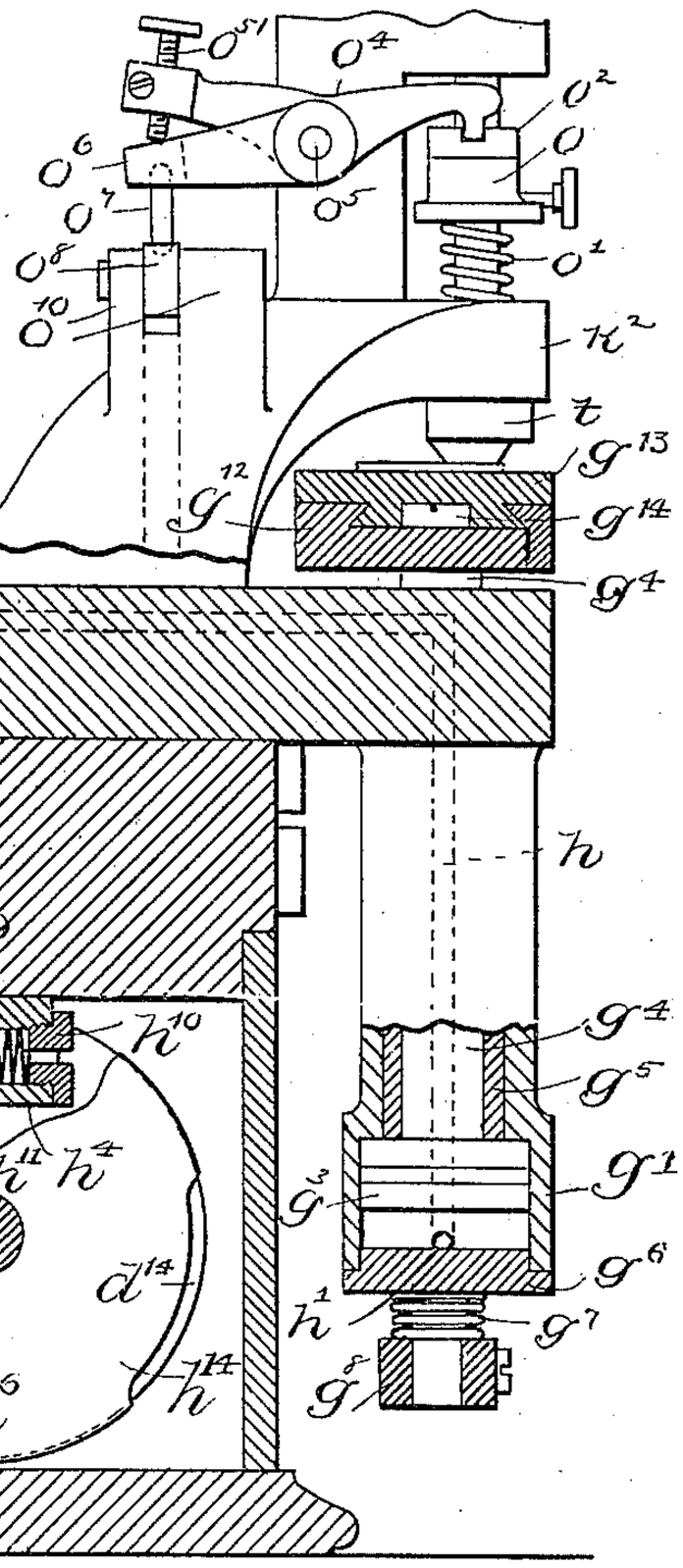
MACHINE FOR TAPERING STEADY PINS.

(Application filed May 5, 1898.)

(No Model.) 6 Sheets—Sheet 5.

FIG. 5.



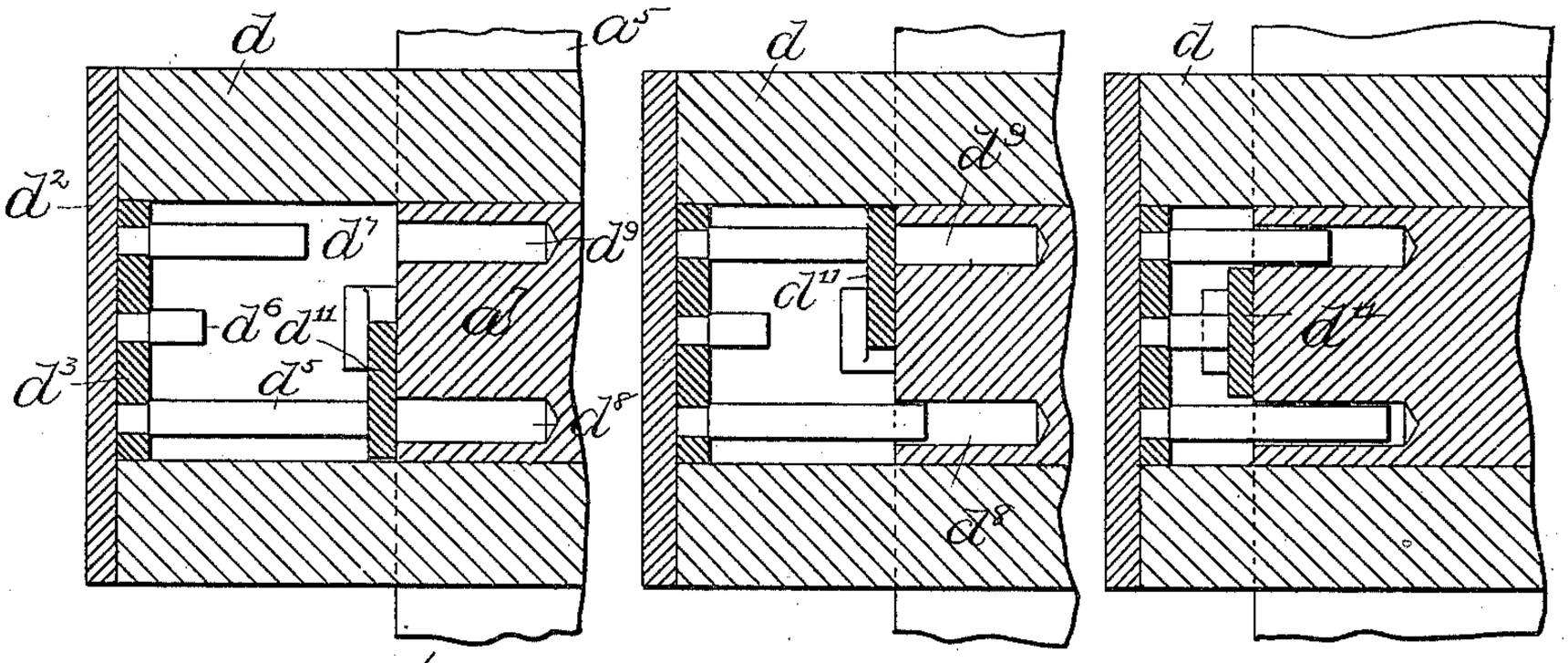


FIG. 6. FIG. 7. FIG. 8.

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No. 652,592 Patented June 26, 1900.

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MACHINE FOR TAPERING STEADY PINS.

(Application filed May 5, 1898.)

(No Model.) 6 Sheets—Sheet 6.

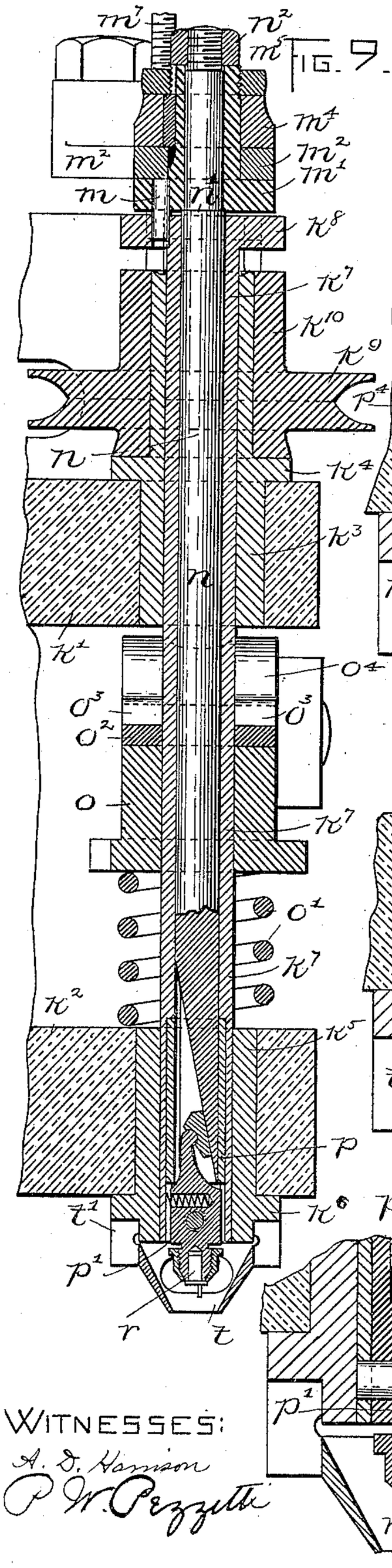

FIG. 9.

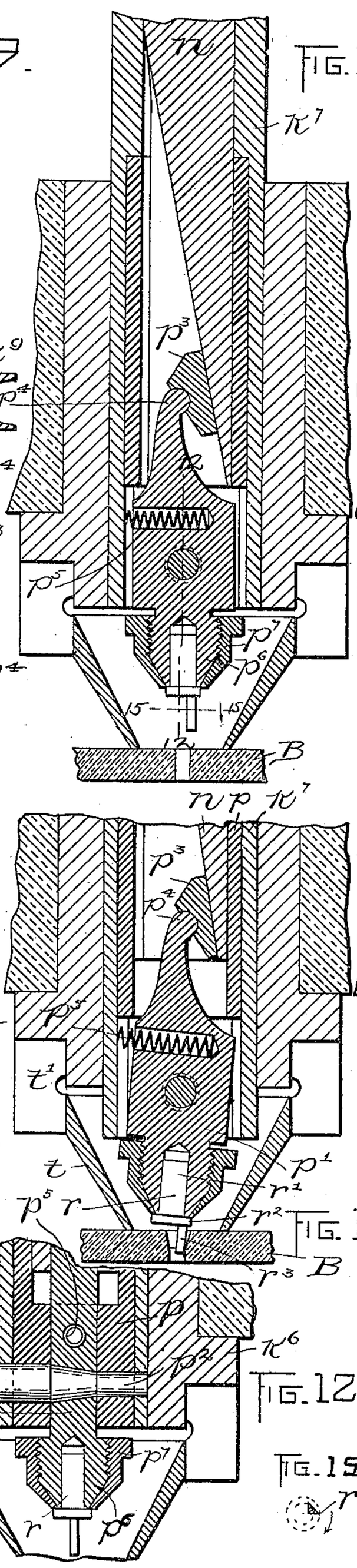

FIG. 10.

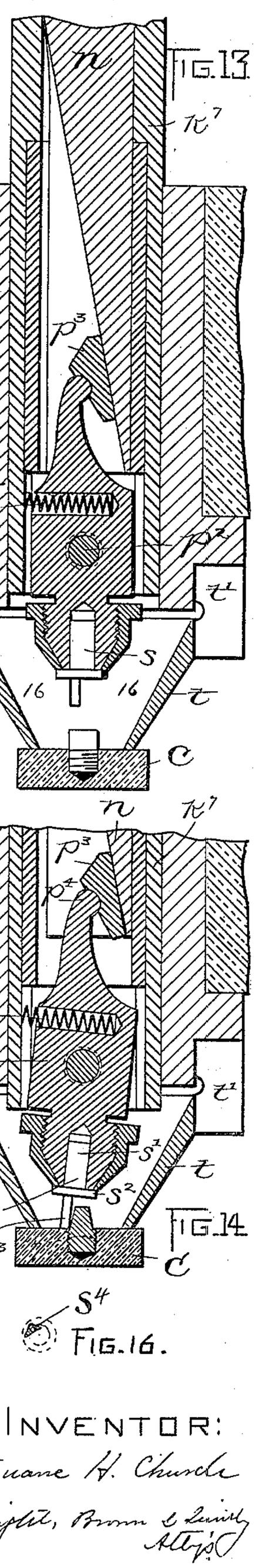

FIG. 13.

FIG. 11.

FIG. 14.

FIG. 16.

FIG. 12.

FIG. 15.

WITNESSES:

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P. W. Pezzetti

INVENTOR:

Duane H. Church

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UNITED STATES PATENT OFFICE.

DUANE H. CHURCH, OF NEWTON, MASSACHUSETTS.

MACHINE FOR TAPERING STEADY-PINS.

SPECIFICATION forming part of Letters Patent No. 652,592, dated June 26, 1900.

Application filed May 5, 1898. Serial No. 679,777. (No model.)

To all whom it may concern:

Be it known that I, DUANE H. CHURCH, of Newton, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Machines for Tapering Steady-Pins, of which the following is a specification.

This invention has relation to machines for performing work on the parts of a watch in the process of construction; and it has for its object the automatic tapering of the dowel-pins and sockets which connect two parts or plates of a watch or hold them in a particular relation to each other.

Heretofore it has been the practice to provide the plates or parts with cylindrical dowel or steady pins and sockets; but this has occasioned more or less difficulty in separating the said parts after they have been connected together. By tapering the pins and sockets the parts may be readily connected and detached; but in watchmaking, where the work is very fine, there is danger of the pins and sockets being tapered to a greater or less extent, whereby they will not fit accurately, and hence another object of this invention is to simultaneously taper a pin and its socket, whereby they shall be exactly supplemental and fit each other with great exactness, inasmuch as the degree of taper of the socket and the pin must be the same and the cutters must operate the same length of time on both.

In the embodiment of the invention hereinafter described at length the work is placed upon the tables, which are reciprocated beneath the cutters and are automatically stopped at predetermined points beneath the latter, so as to present the work thereto. The tables are raised and the cutting-tools are subsequently depressed to cut away the stock, the two spindles on which the cutting-tools are mounted being rotated simultaneously and depressed to the same extent. The tools are secured in tool-holders pivotally connected to the spindles, and as the spindles are depressed the tool-holders are automatically swung upon their pivots to move the cutting points or edges of the tools radially of the spindles. The movement of all the parts of the machine is caused by automatically-acting mechanism set in motion by the operator after the work has been placed upon the tables, and after the tapering of the pins and sockets is completed the tables are moved forward to receive fresh plates and the machine is automatically stopped.

Reference is to be had to the accompanying drawings, and to the letters marked thereon, forming a part of this specification, the same letters designating the same parts or features, as the case may be, wherever they occur.

Of the drawings, Figure 1 represents in front elevation a machine embodying the invention. Fig. 2 represents a rear elevation of the same, a portion of the carriage being shown in section. Fig. 3 represents a central longitudinal section on the line 3 3 of Fig. 1. Fig. 4 represents another longitudinal section on the line 4 4 of Fig. 1. Fig. 5 represents still another longitudinal section on the irregular line 5 5 of Fig. 1. Figs. 6, 7, and 8 represent a series of longitudinal sections upon line 6 6 of Fig. 5 to show the stop-lever in three different positions, whereby it engages either one of the three stop-pins mounted on the carriage. Fig. 9 represents in sectional view and somewhat enlarged one of the spindles and the part which it carries. Figs. 10, 11, and 12 represent still further enlarged sections of the lower end of the spindle and the work-holder for the purpose of illustrating the tapering of one of the sockets, Fig. 12 being a section on the line 12 12 of Fig. 10. Figs. 13 and 14 represent views similar to Figs. 10 and 11 of the tool-holder and the tool for tapering a steady-pin. Fig. 15 represents a similar section on the line 15 15 of Fig 10 of the tool for tapering a socket. Fig. 16 represents a similar section on the line 16 16 of Fig. 14 of the tool for tapering a pin.

Referring to the drawings and to the machine thereon portrayed which I have selected for the purpose of illustration, A indicates the work-bench, on which the machine is placed, the base of the latter comprising a base-plate a, a front wall a', a rear wall a^2, and two side walls a^3 a^4, respectively. In Figs. 1 and 2 the front and rear walls have been removed for the purpose of showing the interior of the machine. Supported upon the side walls is a bed-plate a^5, and journaled in the said side walls between the plates a and a^5 is a shaft b, which I term the "cam-shaft." Upon one end of this shaft is secured a worm-

wheel b', intermeshing with and driven by a worm b^2 on a longitudinally-arranged shaft c, supported in suitable bearings depending from the bed-plate a^5. The shaft c is driven by a belt-wheel c', having its hub secured thereon, and the belt c^2 from the pulley passes around an idler c^3, journaled in the bracket c^4, extending upwardly from the table A. A shipper-lever c^5 is pivoted in a bracket c^6, projecting downwardly from the table, and the rear end is connected by a link to a foot-treadle. (Not shown.) This lever is likewise connected with a clutch mechanism on the counter-shaft, whereby when the front end of the shipper-lever is elevated the belt is driven, and when the said front end is depressed the belt is brought to a stop. I have not deemed it necessary to show these last-named parts, as they are well known and form no part of the present invention.

Mounted upon the bed-plate a^5 is a carriage d, arranged to slide longitudinally thereon. It is provided with a dovetailed slot or groove to receive a dovetailed tongue secured upon the bed-plate, these parts being illustrated in Fig. 2. The bed-plate is provided with a deep comparatively-wide longitudinal groove a^6, in which is placed a cylinder consisting of a block a^7, bored out longitudinally and having its ends closed by the round plugs, plates, or caps a^8 a^9. The end plate or cap a^8 is secured in place by screws a^{10}, passed through the walls of the cylinder; but the end plate a^9 is secured in place by a cross-bar a^{11}, having its ends attached to the end of the bed-plate, as shown in Fig. 13. The block of which the cylinder is formed is broader at the top to provide a dovetailed tongue which lies in the slot or groove in the carriage d. The cylinder is secured in place by screws a^{12} a^{12}, passed upwardly through the bed-plate a^5 into apertures in the under side of the cylinder, there being set-screws a^{13} a^{13}, likewise passed through the bed-plate, but bearing against the under side of the cylinder. These screws not only secure the cylinder in place upon the machine, but they likewise provide for a vertical adjustment of the same, whereby one end or the other or both ends may be adjusted bodily relatively to the base of the machine. Within the cylinder is placed a piston a^{14}, which is longitudinally extended, as shown in Fig. 3, and which is connected to the carriage d by a screw d', having its reduced end passed through a slot a^{16} in the top wall of the cylinder into an aperture in the piston. Air-ducts e e' lead from the ends of the cylinder through the bed-plate and connect with ducts e^2 e^3 in a valve-casing e^{30}, attached to the under side of the bed-plate, as shown in Fig. 3. An air-duct e^4 leads into the valve-casing from a rubber or other pipe e^5, communicating with a compressed-air pipe adjacent the work-plate. A valve e^6 is arranged in the casing and bears against a spring e^7, abutting against an apertured screw e^8, which is threaded into the end of the casing. The valve is reduced at e^9, so as to form an air-chamber which will register with either the port or duct e^2 or the duct e^3, being always registered with the inlet-duct e^4. Exhaust-ducts e^{10} are provided in the valve and the screw e^8, whereby when the chamber e^9 is registered with one of the ducts e^2 e^3 an exhaust-port registers with the other one.

A lever f is fulcrumed on a shaft f', journaled at its ends in brackets f^2, secured upon the base-plate a of the machine, and its upper end bears against the end of the valve. Its lower end is provided with a pin or projection f^3, resting against a periphery-cam f^4 upon the shaft b. Normally the carriage is advanced forward to its greatest extent by reason of the pin f^3 resting upon the depressed periphery of the cam and air being admitted in the rear of the piston, but when one of the projections upon the cam engages the pin f^3 the valve e^6 is shifted and compressed air passes from the duct e^4 through the ducts e^3 and e' into the front end of the cylinder to force the carriage backward. The forward movement of the carriage is limited by means of stopping devices, which I shall now proceed to explain.

To the rear end of the carriage is secured a plate d^2, the carriage being cut away to leave a space between it and the said plate for the reception of a removable plate d^3. This plate d^3 is provided with a socket to receive a spring-pressed pin d^4 in an aperture in the end of the carriage, so that when the movable plate d^3 is inserted in place the pin d^4 engages it and prevents it from dropping out. Secured to the plate d^3 are three stop-pin d^5, d^6, and d^7, all of different lengths, as shown in Figs. 6, 7, and 8, the stop-pin d^6 being the shortest. These pins are arranged in the dovetailed groove on the under side of the carriage, and they project forward in position for the pins d^5 d^7 to enter apertures d^8 d^9 in the block of which the cylinder a^7 is formed. If nothing be interposed to prevent the carriage moving forward, the pins enter the recesses and the carriage continues its movement until the pin d^6 strikes against the end of the cylinder. In order, however, to stop the carriage at certain predetermined positions before it has completed its full forward stroke, a spring-held arm or stop d^{11} is secured upon a shaft d^{10}, arranged longitudinally beneath the machine and journaled in a bracket d^{12}, secured to the under side of the bed-plate. Upon the forward-projecting end of the shaft is secured an arm d^{13}, having a pin or projection resting against a crown-cam d^{14}, rigidly secured upon the cam-shaft b, hereinbefore referred to. The arm d^{11}, which I sometimes term a "stop-lever," extends upwardly behind the rear end of the cylinder into the dovetailed groove in the carriage d. By the cam d^{14} the lever is swung to one side or the other or is permitted to remain in the center, whereby it engages either one of the three pins, as it may be de-

sired. When it is in the central position, as shown in Fig. 2, it is engaged by the central pin d^6 and the carriage moved forward to its fullest extent; but when it is thrust to the right the pin d^5 engages it when the carriage is moved but a short distance, or if moved to the left it is engaged by the pin d^7 after the carriage has moved a little farther forward. The purpose of this stopping of the carriage at different positions is to provide for the cutters operating in succession upon the different steady-pins and sockets in the work placed upon the carriage.

The front end of the carriage is formed with a downwardly-projecting web or plate g and two cylinders g' g^2, and in the lower enlarged end of each cylinder there is placed a piston g^3, having suitable packing material, the piston-rod g^4 extending entirely through it, there being bushings g^5 g^5 in the upper portion of the cylinder, through which the piston-rod g^4 passes. The lower end of the cylinder is closed by an end plate g^6, through which the piston-rod likewise passes, being normally held downward by a spring g^7, abutting against the end plate and against an arm g^8, rigidly secured to the said lower end of the said piston-rod. The arms g^8 g^8 extend in opposite directions in a line parallel to the front face of the machine and at their ends carry pins g^9, passing upwardly through lateral extensions g^{10} of the cylinders. This provision of the arms g^8 and pins g^9 and the lateral arms or extensions g^{10} prevents cramping or binding of the piston and insures an even movement thereof. Upon the upper end of each piston-rod g^4, which is headed or flanged, as at g^{11}, is secured a block g^{12}, having a dovetailed groove to receive a similar tongue of a table g^{13}. The block g^{12} is secured in place by a screw g^{14}, and the under side of the table is grooved for the reception of the head of the set-screw.

To carry air to the cylinder, I provide a duct h, having at one end lateral branches h' h', one leading into the cylinder and having its other end communicating with a groove or chamber h^2 in the under face of the carriage. The duct h passes through the web g, before described, and through the carriage, being formed therein in any suitable way. Communicating with the elongated groove h^2 is a duct h^3, which passes through the bed-plate downwardly into a valve-casing h^4, secured to the under sides thereof. The valve-casing has a duct h^5, communicating with a rubber or other compressed-air tube h^6, secured to a nozzle, through which the duct h^5 extends. A valve h^7 is arranged to slide longitudinally in the valve-casing, and it is provided with a groove h^8, adapted to register with the duct h^3 when the valve is in one position and with an exhaust-duct h^9 to register with the duct h^3 when the valve is in the other position. The exhausted air passes through the duct h^9 and through a small aperture in a screw or block h^{10}, which closes the valve-casing h^4 and between which and the valve a spring h^{11} is placed. A lever h^{12} is pivoted or fulcrumed upon the shaft f', which was before described as being supported in the brackets f^2, extending upwardly from the base-plate a'. The lower end of the lever h^{12} has a pin h^{13} resting upon the periphery of the cam h^{14}, secured upon the cam-shaft b. When the projections on the periphery of the cam engage the projections or stud h^{13} of the lever h^{12} the valve h^7 is thrust forward against the tension of the spring h^{11} into the position shown in Fig. 5, whereby compressed air passes from the tube h^6 into the cylinders g^2 g^3 and the pistons are forced upwardly, carrying with them the tables g^{13} g^{13}, upon which the work is placed. From this description it will be clear that while the two cylinders receive air from the same source yet the pistons and the tables are entirely independent of each other, and consequently can be moved simultaneously according to the work that is placed upon each table. For instance, if one of the parts upon one table be relatively thick and the part upon the other table be relatively thin the pistons will be moved to carry the surface of the work to the proper plane irrespective of their different degrees of thickness.

The machine which I am now describing is particularly adapted for tapering two steady-pins and two sockets, one pin and one socket being simultaneously operated upon, after which the next pin and socket will be tapered. Consequently the cam which operates the valve by means of which the passage of air to the cylinder a^7 is controlled is constructed so that the carriage is moved from its forward position to its rearmost position and then forward until the pin d^5 engages the lever d^{11}, where it remains while one pin and one socket are being tapered, the tables having risen immediately upon the carriage being moved forward. Then when this operation has been completed the carriage is moved back to its rearmost position and then again forwardly until the pin b^7 engages the lever d^{11}, which has been shifted into the position shown in Fig. 7. Then the next pin and socket are tapered, the tables having again arisen to present them to the cutter. When this cutting operation is completed, the carriage is moved backward and then forward to the full end of its throw, the lever d^{11} having been shifted to its former position, as shown in Fig. 8. The cams are so timed that air is not admitted to the cylinders g' g^2 until the carriage has come to a state of rest beneath the cutters.

I shall now describe the cutters and their adjustable parts, together with the mechanism by means of which they are rotated to move longitudinally. Upon the top of the bed-plate is secured, by means of screws or other suitable fastening devices, an arch k, which spans the carriage, as shown in Fig. 1, this arch being provided with a vertical web

or extension k^{15}, supporting the spindles and the cutters. As shown in Fig. 3, the web is formed with two parallel horizontal flanges k' k^2 in its front face. In the upper flange k' are placed two bushings k^3 k^4, (see Figs. 1 and 9,) each having a circumferential flange k^4 midway between its ends. Bushings k^5 are placed in apertures in the lower flange k^2, and have circumferential flanges k^6 lying below the under side of the said rib or flange. Projecting through the bushings are hollow spindles k^7, each formed at its upper end with a head k^8, having clutch-teeth. A pulley k^9 is placed loosely upon each of the bushings k^3, and placed around the same bushings above the pulleys are loose clutch-sleeves k^{10}, which have teeth at both ends, one set to intermesh with the teeth upon the spindles and the other set to mesh with the teeth on the hub of the pulleys. The teeth of each clutch-sleeve are long enough to permit the hollow spindle to move up and down without being disengaged from it and from the pulley, this up-and-down movement of the spindle being necessary to carry the tool longitudinally to taper the work, whether it be the socket or the pin. The pulleys are driven continuously by a belt or belts which pass around them and which are caused to travel by one or more pulleys on the counter-shaft. Each spindle is connected by a pin m with a bushing m', passed through an arm m^2, secured to a slide-bar m^3, arranged in a vertical aperture in the extension k^{15} of the arch k. The collars m^4 surround the bushing and are keyed thereto, there being a nut m^5 threaded upon each bushing, which binds the collar m^4 tightly against the arm m^2. A bar n is passed through each hollow spindle, it being formed with a shoulder n' abutting against the bushing m' and secured firmly thereto by a nut n^2, screwed upon the threaded end of the said bar, the said nut bearing against the other end of the bushing. Thus the bar being rigidly secured to the bushing is normally incapable of longitudinal movement, (except for the purpose of adjusting it, as I shall subsequently describe,) yet by reason of the bushing being connected with the hollow spindle by the pin m it is free to turn therewith, the said bushing m' being rotatably secured in the said arm m^2. Each bar m^3, before referred to, is connected at its lower end with a spring m^6, passing down through the arch, as shown in Fig. 2, and an adjusting-screw m^7 is passed through each arm m^2 and rests upon the top of the extension k^{15} of the arch, as shown in Figs. 3 and 4. By turning these screws the bars n may be raised or lowered, the springs m^6 always holding the ends of the screws against the arch.

Placed loosely upon each spindle and resting upon the collar o is another collar o^2, having notches in its upper end to receive downwardly-projecting fingers o^3 on a bifurcated or forked end of a lever o^4, pivoted upon a stud o^5, projecting out from the side of the arch k. The rear end of each lever is provided with an adjusting-screw o^{51}, and the two adjusting-screws of the two levers o^4 o^4 bear against a bent bar o^6, having its ends fulcrumed upon the studs o^5, which project from the opposite sides of the arch. This bar o^6 bears against a pin o^7, extended upwardly from a lever o^8, having one end fulcrumed in the ears o^9, extending upward from the side of the arch. The free end of the lever is movable between the ears o^{10}, extending upwardly from the other side of the arch, and bears upon a vertically-movable rod o^{11}, sliding in an aperture through the arch and through the bed-plate, as shown in Fig. 1. The lower end of the rod or bar rests upon a lever o^{12}, fulcrumed on a stud o^{13}, projecting out from the bed-plate and having a projection or pin o^{14}, resting upon a cam o^{15}, rigidly secured to the cam-shaft b. There are two rises to this cam, which are so graduated that when the carriage is in the proper position the rod o^{11} is raised and the spindles are depressed to carry the tool down to the work, the springs o' raising the spindles when the rises on the cam pass the pin or stud o^{14}.

The spindles, as before stated, carry the cutting-tools, and by referring to Figs. 9 to 12, inclusive, it will be seen that in the lower counterbored end of each one of them is a bushing p, having a contracted aperture with parallel opposing walls, in which is placed a tool-holder p'. A pintle or pivot-pin p^2 is passed through the end of the spindle, the bushing, and the tool-holder, whereby the latter is allowed to oscillate about its center, the pin p^2 at its center and the aperture in the tool-holder both being tapering, whereby wear of the parts may be compensated for by driving the pin in farther.

The lower end n^3 of the bar n is wedge-shaped by reason of its being beveled or chamfered, and between the beveled face of the rod and the upwardly-projecting reduced end p^4 of the tool-holder is a bearing-block p^3, having a semispherical socket to receive the said end p^4, which is spherical or ball-like. A coiled spring p^5 is placed in a transverse socket in the tool-holder, and it bears against the bushing p, so as to hold the end p^4 of the tool-holder against the block p^3 and the block against the beveled or wedge-shaped end of the bar n.

The lower end of the tool-holder is formed as a wedge-chuck having a tapering externally-threaded nipple p^6 in an aperture in which the tool r or s is placed, there being a wedging-collar p^7 secured on the nipple to bind the walls of the nipple against the tool. The tool r is intended for tapering the socket in the one part of the watch, and the tool is for tapering the dowel or steady pin on the other part of the watch, and consequently they are different with respect to their cutting edges or points.

Each tool has a spindle r' or s', a head r^2 or s^2, and a projecting cutter r^3 or s^3. The cut-

ter is preferably triangular in transverse section, and when it is to taper the socket its cutting-point r^4 is that angle of the triangle which is farthest from the center of the tool, (see Fig. 15;) but when its cutting-point s^4 is to cut the pin it is the angle of the triangle which is nearest the center of the tool, as shown in Fig. 16. Now when the spindle is rotated and is depressed it carries the rotating tool downward with it, and as it travels down the block o^3 slides down the chamfered face of the end of the stationary bar n, and the tool-holder is swung upon its pivot and the cutting edge or point of the tool is carried toward or away from the center of rotation of the spindle. When the socket is to be tapered, the tool travels toward the center, but away from it when the pin is to be tapered, as shown in Figs. 11 and 14, and to accomplish this difference in movement the bars n are adjusted vertically by the set-screws m^7 to swing the lower ends of the tool-holder outward or inward, as the case may be. Assuming that a pin is to be tapered, the bar n for the pin-cutter is adjusted to cause the point of the cutter to be moved outward from the axis of rotation of the spindle until it is at a distance from the center of the pin equal to the smallest radius of the finished pin, and then when the spindle is rotated and lowered the block p^3 slides down the inclined end of the bar n and the point of the tool moves outward gradually, as shown in the last-mentioned figures. If a socket is to be tapered, the bar n is adjusted until the cutting-point is beyond the center of motion, so that it will move inward gradually upon the depression of the spindle.

To the lower projecting end of the bushing k^5 is frictionally attached the split hub t' of a frusto-conical guard t, against which the work or plate B or C is pressed by the table on which it is secured, the plate B being the main plate of a watch and the plate C being the pillar-plate, which are usually connected by dowel or steady pins.

Upon the worm-wheel b' is a pin o^{20}, which, when the cam has made a complete rotation, engages the end of a lever o^{19}, fulcrumed on a stud in the base-plate, and moves it to one side. This lever has in its lower end a socket o^{18}, into which a pin o^{17} on the lever c^5 extends when the front end of the latter is raised and prevents it from dropping. Upon the completion of the work the pin o^{20} engages the lever o^{19} and frees the lever c^5, whereupon the belt c^2 immediately stops.

In order to hold the spindles against rotation when the tools are being secured in the work-holders, the operation of the machine is as follows: The watch-plate carrying the pins is placed upon one of the tables, so that the pins are in a line parallel to the central longitudinal line of the machine, the position of the plate being determined by pins on the work-plate or else by fastening devices carried thereby, and the other plate in which the sockets are formed is secured upon the other work-table, with the sockets in a line parallel to the line of the pins. This plate is similarly secured in place upon its table, and the machine is then ready to be started. To accomplish this last, the operator depresses the treadle (not shown) and swings the rear end of the lever c^5 upwardly until its pin o^{17} drops into the socket o^{18} in the lever o^{19}, as shown in Fig. 3. Immediately upon the depression of the lever the belt c^2 is driven, and it imparts a rotary movement to the shaft c and from thence to the cam-shaft b through the medium of the worm b^2 in the worm-wheel b', the spindles being rotated continuously by the belts which pass around the pulleys thereon. As the cam-shaft b begins its rotation a projection on the cam-wheel f^4 engages the lever f and shifts the valve e^8 to permit compressed air to pass into the front end of the cylinder a^7 and force the carriage d back to the rear end of its throw. At this time the cam-wheel d^{14} engaging the lever d^{11} throws it to one side into the position shown in Fig. 6, where it remains in alinement with the stop-pin d^5. As soon as the carriage reaches the rear end of its throw the cam f^4 is rotated far enough to let the lever f slip off from the projection, whereupon the valve e^8 is shifted again by its spring and the carriage is driven forward until the pin d^5 engages the stop-lever d^{11}, the carriage remaining at this point by reason of the pressure of air against the rear end of the piston a^{15}. As soon as the carriage comes to a full stop the cam-wheel h^{14} engaging the lever h^{12} throws it into position to permit air to pass through the ducts h^3 and h into the lower end of the cylinder g^2 g^3 on the carriage, and the tables are immediately raised until the work-plates are held or pressed against the guards t on the lower ends of the bushings k^5, supported by the arch k. After the tables have been raised the cam o^{15} engaging the lever o^{12} causes it to lift the pin or bar o^{11} to swing the levers o^4 about their centers of motion, and thereby depress the rotating spindles which carry the tool-holders in the tools. As the spindles move downward the tools engage a pin and the stock surrounding an aperture and taper them in the manner previously described, the blocks p^3 sliding down the chamfered faces of the bars n to accomplish this. The pin and socket are tapered to the same extent, so that the former fits accurately in the latter. As soon as the cutting is finished the work-plates are lowered by reason of the cam h^{14} turning far enough to permit the springs h^{11} to force the valve h^8 into position to permit the air to be exhausted from the cylinders g^2 g^3, and thereupon the carriage is immediately carried back to its rearmost position by reason of the cam f^4 turning far enough for the spring e^7 to thrust the valve e^8 back into its original position, whereby air is exhausted from the rear of the piston a^{15} and is admitted in front

thereof. While the carriage is moving back the stop-lever d^{11} is swung over by the cam d^{14} to the position shown in Fig. 7, where it is in alinement with the pin d^{7}. Then the carriage is advanced again until the last-named pin strikes against the lever, thus bringing the second steady-pin and the second socket in alinement with the centers of motion of the two spindles which carry the tools. Then the work-tables are again raised and the spindles are depressed to act upon the work. When this second cutting is accomplished, the spindles are raised and the work-tables are dropped and the carriage again moved back to permit the stop-lever d^{11} to be swung into a central position, as shown in Fig. 8, whereby when the carriage is advanced the work-tables are carried out from under the spindles for the removal of the finished work and the reception of new watch-plates.

The cutting-tools are capable of very fine adjustment, for, in addition to the bars n being adjustable to vary the throw of the tool-holders, the movement of the spindles may be varied through the medium of the levers o^{4}, the bar o^{6}, and the set-screws o^{5}. In any event, however, though the spindles may be adjusted longitudinally relatively to each other, yet they are always moved to the same extent when they are depressed to carry the tools against the work, this being necessary to cause the pin and socket to be tapered to the same extent.

The pins and sockets are cut so as to accurately register, as will be readily appreciated, for when they are cut singly it is exceedingly difficult to insure that the distance between the pins is exactly equal to that between the sockets; but when devices are employed for feeding both parts of the work forward simultaneously to the same extent it is evident that the cutters must operate to taper the pins and sockets, so that they will register with the greatest accuracy.

It will be understood that the machine may be arranged to taper more than two pins or sockets successively and that the tapering of the pins may be accomplished upon one machine and the tapering of the socket upon another one.

Having thus explained the nature of the invention and described a way of constructing and using the same, though without attempting to set forth all of the forms in which it may be made or all of the modes of its use, I declare that what I claim is—

1. A machine having a tool for tapering a pin, a tool for tapering a socket for the pin, and means for holding the work.

2. A machine having a tool for tapering a pin, a tool for tapering a socket, and means for automatically presenting the work a predetermined number of times to said tools.

3. A machine having a tool for tapering a pin, a tool for tapering a socket, and a work-table movable relatively to said tools.

4. A machine having a tool for tapering a pin, a tool for tapering a socket, means for presenting the work to said tools, and means for causing said tools to operate simultaneously on the pin and the socket.

5. A machine for tapering a pin and its socket in watch-plates, comprising two rotatory tools, one for tapering a pin and one for tapering a socket, a reciprocatory carriage, a table on the carriage for the work, and mechanism for causing said tools to act simultaneously upon the pin and socket.

6. A machine for tapering a pin and its socket in watch-plates, comprising a rotatory tool for tapering the pin, a rotatory tool for tapering the socket, automatically-reciprocated work-tables, one for each plate, and mechanism for causing the tools to operate simultaneously upon said plates.

7. A machine for tapering a pin and its socket in watch-plates, comprising a rotatory tool for tapering the socket, a carriage having a table for the watch-plates, and mechanism for automatically moving and stopping the carriage to present the said plates at different points to the action of the tools.

8. A machine for tapering the steady or dowel pins or the sockets in a watch-plate, in succession, comprising a rotatory tool, a work-table, and mechanism for causing the tool to act upon the pins or sockets successively.

9. A machine for tapering the steady or dowel pins or the sockets in a watch-plate, in succession, comprising a rotatory tool, a work-table, and mechanism for automatically moving the table to present the pins or sockets in succession to the action of the tool.

10. A machine for tapering the steady-pin or the socket in a watch-plate comprising a rotatory tool, a carriage, a pneumatic device for reciprocating the carriage, a work-table, a pneumatic device on the carriage for reciprocating the work-table, and automatically-acting mechanism for admitting air at predetermined intervals to the said pneumatic devices.

11. A machine for tapering the steady-pin or the socket in a watch-plate comprising a rotatory tool, a work-table reciprocatory in the plane of the work, a rotary spindle carrying the tool, mechanism for automatically moving the table toward the tool in lines transverse of the plane of the work, and mechanism for automatically moving the spindle and tool toward the table to act on the work.

12. A machine for tapering the steady-pin or the socket in a watch-plate comprising a rotatory tool, a work-table, a carriage supporting the work-table and on which it is movable, a rotary spindle carrying the tool, and automatic mechanism for moving the carriage into position, then moving the work-table toward the tool, and finally moving the tool and the spindle toward the table.

13. A machine of the character specified, comprising a bed-plate, a rotary tool, a carriage slidable on the bed-plate, a work-table

carried by the carriage, means for reciprocating the carriage, and automatic devices for stopping the carriage at two or more predetermined points in succession.

14. A machine of the character specified, comprising a bed-plate, a rotary tool, a carriage slidable on the bed-plate, a work-table carried by the carriage, means for reciprocating the carriage, automatic devices for stopping the carriage at two or more predetermined points, and means for moving said work-table relatively to the tool each time the carriage is stopped at a predetermined point under the tool.

15. A machine of the character specified, comprising a rotatory spindle, a tool carried by the spindle to rotate therewith and projecting longitudinally from the extremity thereof, and means for automatically moving the cutting point or edge of said tool relatively to the spindle while the latter is rotating to taper a pin or a socket.

16. A machine of the character specified comprising a rotatory longitudinally-movable spindle, a tool-holder pivoted upon the spindle and projecting longitudinally from the extremity thereof and mechanism for swinging said tool-holder upon its pivot while the spindle is rotating to taper a pin or a socket.

17. A machine of the character specified comprising a rotatory spindle, a tool-holder pivoted to said spindle to rotate therewith, a tool in said holder, means for moving said spindle longitudinally, and mechanism for moving the tool-holder to cause the cutting-point of the tool to move radially of the spindle.

18. A machine of the character specified comprising a rotatory spindle, a tool-holder pivoted to the spindle to rotate therewith, and a wedge for automatically moving the tool-holder radially of the spindle.

19. A machine of the character specified comprising a rotatory spindle, a relatively-stationary wedge passed through said spindle, a work-holder connected to said spindle to turn therewith and engaging said wedge, and mechanism for moving the spindle relatively to the wedge whereby the work-holder slides along the wedge, and the tool is caused to taper a pin or socket.

20. A machine of the character specified comprising a tool-holder, a rotatable spindle to the lower end of which the said holder is pivotally connected, mechanism for moving the spindle longitudinally, a wedge engaging the work-holder and relatively to which the spindle is movable, and means for adjusting the wedge.

21. A machine of the character specified, comprising two rotary spindles, means for moving said spindles longitudinally, devices for adjusting said spindles independently relatively to the said means, tool-holders carried by the spindles, relatively-stationary wedges for engaging the tool-holders, and mechanism for adjusting said wedges independently of each other.

22. A machine of the character described, comprising a tool for tapering the pins on one piece of the work, a tool for tapering the sockets in the other piece of the work, and mechanism for automatically feeding and stopping both pieces of work below the said tools, whereby when the work is finished the pins and sockets will accurately register.

23. A machine of the character described, comprising a tool for tapering the pins on one piece of work, a tool for tapering the sockets in the other piece of work, and mechanism for automatically positioning the tools and pieces of work with respect to each other whereby when the work is finished, the pins and sockets will accurately register.

In testimony whereof I have affixed my signature in presence of two witnesses.

DUANE H. CHURCH.

Witnesses:

MARCUS B. MAY,

P. W. PEZZETTI.