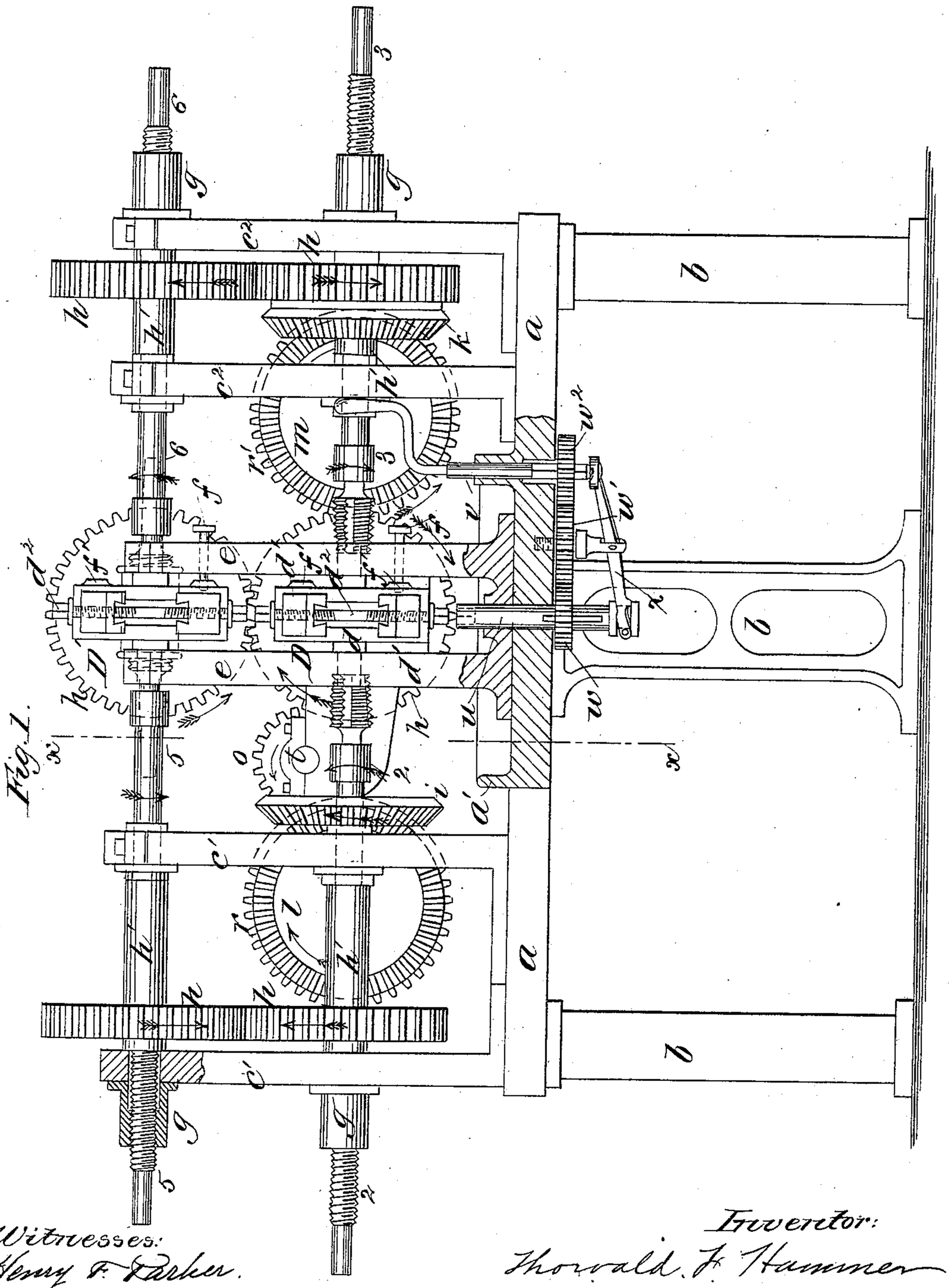
(No Model.)

3 Sheets—Sheet 1.

T. F. HAMMER.

SCREW TAPPING MACHINE.

No. 321,023. Patented June 30, 1885.



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(No Model.) 3 Sheets—Sheet 2.

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SCREW TAPPING MACHINE.

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Fig. 4.

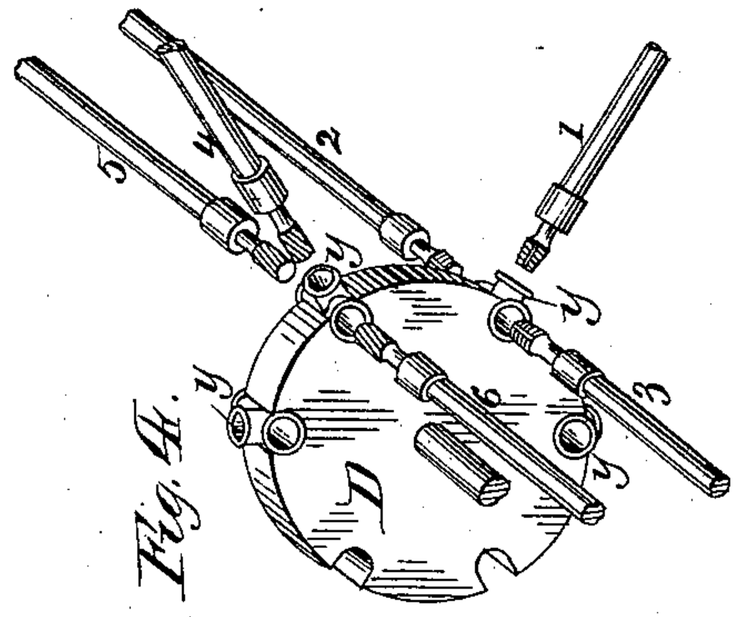

Fig. 2.

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(No Model.) 3 Sheets—Sheet 3.

T. F. HAMMER.

SCREW TAPPING MACHINE.

No. 321,023. Patented June 30, 1885.

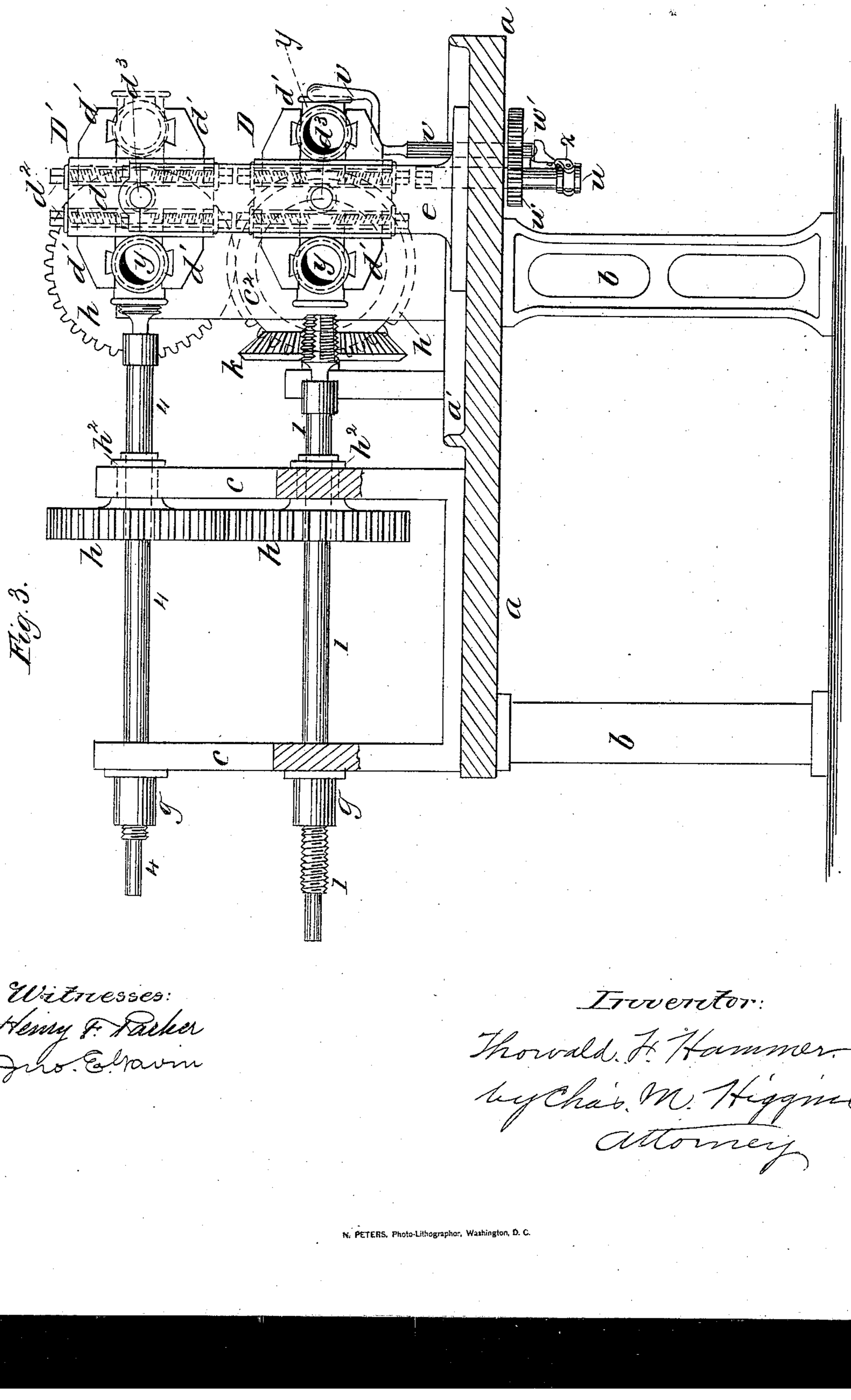

Fig. 3.

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UNITED STATES PATENT OFFICE.

THORVALD F. HAMMER, OF BRANFORD, CONNECTICUT.

SCREW-TAPPING MACHINE.

SPECIFICATION forming part of Letters Patent No. 321,023, dated June 30, 1885.

Application filed January 18, 1884. (No model.)

To all whom it may concern:

Be it known that I, THORVALD F. HAMMER, of Branford, in the county of New Haven and State of Connecticut, have invented certain new and useful Improvements in Screw-Tapping Machines, of which the following is a specification.

My invention relates to that class of machines designed for performing the operations of drilling, reaming, or tapping upon a number of blanks or upon a number of sides of the same blank at the same time, and in which a number of spindles are alternately fed to and from a rotary chuck in which the blanks are held, and which chuck is partially revolved when the spindles retire in order to bring a fresh set of blanks into position to receive the next action of the taps, while the former tapped blanks are removed. Several machines of this character have been heretofore designed involving different arrangements of spindles and connecting-gearings and chucks, the object in all such arrangements being to produce a machine with a large number of spindles, so designed as to be capable of acting on a great number of blanks, or on several sides of a many-sided blank at the same time, so as to perform a large amount of work rapidly, and yet enable one operator to attend to the feed of the machine. Some of the machines of early design were constructed with six spindles arranged in two overlying and parallel tiers of three each, and these spindles were all so mutually geared as to revolve in the same direction and to advance or retire simultaneously to or from a multiple chuck or vise fitted to rotate on a vertical axis in front of the group of spindles, and adapted to hold six blanks to receive the simultaneous action of the taps or tools of the spindles, this chuck being partially revolved after the taps retire, so as to bring a fresh set of blanks into position and allow the tapped ones to be removed. In a machine of later design three spindles were arranged to converge toward a centrally-arranged chuck adapted to hold three blanks, or a three sided blank, to receive the action of the spindles. These three spindles were arranged in a common horizontal plane, and adjoining this radial group of three was arranged a second similar group in the same horizontal plane, converging toward a separate chuck in the manner of two distinct machines arranged side by side. Both machines were, however, so geared as to operate simultaneously, but in reverse order, one set of spindles being advanced toward one chuck while the second set were retiring from the second chuck. This second type of machine, while an improvement in some respects on the former, and adapted for a different class of work, was yet open to the objection of being cumbersome, and of occupying the space of two machines, and in acting on chucks placed at lateral distances so far apart that the operator had to change his position from one chuck to the other in order to attend to the feed of the machine, or rather machines. Now, my present invention may be said to partake somewhat of the features of both types; but it avoids the defects of each, and presents characteristic and important advantages in that it produces a very compact machine capable of acting upon a number of many-sided blanks at the same time, and of thus producing rapidly a great amount of work, and yet it occupies small floor-space, involves simple gearing, and does not require that the operator change his position in order to attend to the feed of both chucks. In my invention I arrange the spindles in two or more groups or tiers, one overlying or parallel with the other, the spindles of each tier converging to a common center, at which centers are placed two rotary chucks arranged one directly over the other, corresponding with the respective groups of spindles, and all the spindles are so mutually geared that they act simultaneously, but each tier in reverse order, the lower group advancing while the upper retires, or vice versa, which arrangement, as will be readily understood, possesses the important advantages above set forth. These two tiers of radial spindles may be geared in any suitable way, so as to act in reverse order, but I prefer to fit each set of spindles with simple spur-gear wheels, so that when one set of spindles is placed over or parallel to the other the respective spur-wheels of each set will directly intermesh, so that if power is applied to revolve the spindles of one tier in one direction the spindles of the other tier will necessarily revolve in the reverse direction by virtue of the simple direct gearing of the two, thus rendering the group-

ing and individual gearing of the spindles very simple, compact, and effective. My invention, therefore, lies mainly in the features above outlined, and also in certain details connected therewith, and in peculiar wrench mechanism for acting on the jaws of the lowermost chuck, as hereinafter fully set forth.

In Patent No. 311,311, issued January 27, 1885, to Frederick Grinnell, is shown a form of tapping-machine closely related to mine in having two tiers of tapping-spindles placed one over the other and geared to act reversely, the spindles of each tier converging to centers at which are placed chucks one above the other, corresponding to the tiers; but the construction of my machine is specifically different in the nature of the fixed frame-work, the connecting-gearing of the spindles, the form and arrangement of the chucks and their adjuncts, as hereinafter set forth and claimed.

In the drawings annexed, Figure 1 presents a front elevation of my improved multiple boring or threading machine, shown partly in section at the base of the chucks. Fig. 2 is a plan view of the machine, and Fig. 3 is a cross-section on lines *x x* of Figs. 1 and 2. Fig. 4 is a diagram illustrating a slight modification.

Referring to the drawings, particularly Fig. 2, it may be noted that in plan view the general form of the machine may be said to be that of a crude inverted **T**, the transverse portion of the **T** being the front of the machine, where the chucks are situated and where the operator stands.

a indicates the bed-plate or bottom of the machine, which is of the **T**-form before noted, each member of the **T** being firmly supported on the legs or standards *b*, (see Figs. 1 and 2,) which thus provide three points of support, an arrangement which is at once the most stable and the most simple.

1, 2, 3, 4, 5, and 6 indicate the spindles of the machine, which, it will be seen, are six in number, disposed in horizontal overlying and parallel tiers of three each, the spindles of each tier being arranged also in a **T** form, corresponding to the members of the frame or bed *a*, and converging to a common center. This center is at the jaws of the chucks, (indicated by D D′,) and which are mounted on the front of the bed *a*, just in front of the converging point of the spindles, as shown in Figs. 1 and 2. These chucks D D′ are preferably what are known as simple "box-chucks," as shown best in Figs. 1 and 3, but which in my case are double, consisting of a central metallic box-shaped block, *d*, fitted with adjustable clamps or vise-jaws *d′*, on two opposite sides, which are operated by square-headed screws d^2. These chucks are so arranged one above the other, between two supporting-standards, *e e*, on the front of the machine, as to present one set of jaws outward in front of the operator, to receive the blank, while the second set of jaws are directed inward toward the converging point of the spindles, so as to present the blank held therein to receive the triune action of the spindles, as will be readily understood. The blocks of the chucks are formed with central trunnions, d^3, which are journaled in the standards *e e*, at such a distance one above the other that each chuck is capable of being revolved independently of the other so that after one set of spindles have retired the chuck corresponding thereto may be revolved to bring the second set of jaws with a fresh blank into position to receive the next action of the spindles, while the first set of jaws with the finished blank is brought to the front to enable the finished blank to be removed to give place to another blank, as will be readily comprehended. The chucks are held firmly in either of these positions by a spring-bolt, *f*, (see Fig. 1,) which engages with either of two sockets, *f′*, on the blocks of the chuck, which is the usual mode of holding such chucks. The bed-plate *a* is formed with a raised oval rim, *a′*, around the base of the chuck-standards *e e*, and under the converging point of the spindles, so as to retain the borings from the tools and the lubricant drippings therefrom, as usual in such machines. Now, the lower spindles are indicated by 1 2 3, and the upper spindles by 4 5 6, and for convenience I shall term the spindles 1 4 the "central spindles," and the remaining spindles the "front spindles," as the latter show on the front of the machine, as seen best in Fig. 1. Each vertical pair of the spindles is mounted or journaled in suitable bearings on a pair of standards, *c c′* c^2, and are free to revolve as well as to move longitudinally therein, the outer ends of the spindles being screw-threaded and engaging in screw sleeves or nuts *g*, which are fixed to the outer bearing-standards, so that if the spindles are revolved one way or the other they will advance to or retire from the chucks with a positive screw-motion, as usual in machines of this class. The spindles are of course provided with suitable chucks or sockets at the working end to receive drills, reamers, taps, or other tools in the usual manner, taps being illustrated in the drawings, and in this case the thread of the taps must of course match with the threads on the ends of the spindles and in the sleeves *g*, as usual. Now, each spindle is provided with a simple spur-gear wheel, *h*, which spur-wheels are all of equal size, and when one spindle is set above the other, as shown best in Figs. 1 and 3, these spur-wheels directly intermesh; consequently, if the lower spindles revolve in one direction, the upper spindles by this simple direct gearing are necessarily made to revolve in the reverse direction; hence it will be seen that as each vertical pair of spindles are geared directly by the spur-wheels *h* it only remains to gear the central and front spindles of one tier together to enable all the spindles to be operated in the desired order by applying power to one of them or at one point in the train of gearing, and to accomplish this I make use of some additional spur-gearing with miter-gearing between the central and front spin-

dles of the lower tier—that is, I affix on the lower front spindles, 2 3, the bevel or miter wheels *i k*, which mesh with similar miter-wheels, *l m*, fixed on the end of short shafts *n n'*, (see Fig. 2,) which are mounted in ordinary bearings on standards *p p'*, which are arranged on each side of the lower central spindle, 1, these shafts *n n'* being on a level with the lower spindles, as will be understood.

Upon the back or inner ends of the shafts *n n'* are fixed spur-wheels *r r'*, similar to the spur-wheels *h* of the spindles. The spur-wheel *r'* of the shaft *n'* gears directly with the spur-wheel *h* of the lower central spindle, 1, while the spur-wheel *r* of the shaft *n* gears with one side of a pinion, *o*, which is geared at the opposite side with the spur-wheel *h* of the leading spindle 1. This pinion *o* is therefore the driving or initial pinion, and is fixed on the driving-shaft *t*, which is mounted in bearings on the standards *c c* of the central spindles, 1 4, and provided with the driving-pulley *t'*, to which power may be applied by a driving-belt in the usual manner. It will be understood that the spindles are fitted to slide upon a key through their spur-wheels *h*, so that each spindle is engaged rotatively with its wheel, but free to move longitudinally through the hub of the same and through the bearings, in obedience to the action of its screw-threads, while the spur-wheels are restrained from any such longitudinal motion. The wheels *h* on the front spindles are thus restrained by the long hubs or sleeves *h'*, abutting between the bearings, while the wheels *h* on the central spindles are similarly restrained by shouldered hubs h^2, engaged in the front journal-boxes, as shown in Figs. 1, 2, and 3. It will now be seen that the described gearing of the spindles is such that if the driving-pinion *o* revolves in the direction of the arrow shown in Figs. 1 and 2, all the other gear-wheels will revolve in the different directions indicated, the result being that all the upper spindles will screw toward the blank held in the upper chuck, and the taps will therefore enter the three sides of the blank, and thus properly tap the openings therein simultaneously, while at the same time the three lower spindles will screw outward and withdraw or unscrew their taps from the blank in the lower chuck, whereas if the driving-pinion *o* is revolved in the reverse direction then the motion of the two sets of spindles will be reversed, the upper tier being screwed out while the lower tier will be screwed in. It will therefore be readily seen that for the number of spindles used the gearing is very direct and simple, and by having the spur-wheels *h* of one tier directly superposed upon and intermeshed with those of the lower tier, then the intermediate or miter gearing, *r l i*, &c., is needed only between the lower spindles, as the upper tier of spindles receive reverse motion directly from the lower ones, hence there is no need of intermediate gearing between the upper and lower spindles, which renders this arrangement peculiarly simple and direct. It will be readily understood that but a little motion need be imparted to the spindles in their outward and inward travel, provided this motion or "stroke" is ample to tap the blanks to the required depth, and to properly clear the blanks when the taps are fully withdrawn, as indicated in Fig. 1. The motion of the driving-shaft *t* should be reversed at the end of each stroke, so as to produce the proper alternate advance and retreat of the spindles and their taps. This reversal may be done by the operator himself shifting a belt-shipping or clutch-shipping lever at each end of the stroke in the same manner as in operating a screw-cutting lathe, so as to shift the belts or clutches on the countershaft from which the driving-belt of the driving-shaft *t* is driven. I greatly prefer, however, to adopt any of the automatic reversing devices used in machines of this class, in which stops or collars on one of the screw-spindles operating a tripping device will automatically shift the belt or clutch at each end of the stroke, and thus produce a regular and limited alternate forward and backward movement of the spindles. These devices I however have not shown in the drawings, as they form no part of my present invention, are of various kinds well understood by mechanical experts familiar with this class of machines, and therefore need no detailment here, particularly not as their use is not necessary in this machine, since the reversal may be accomplished, as before described, by the manual shifting of the driving belt or clutches in the same way as in an ordinary screw-cutting lathe.

The general construction of the machine having been now set forth, its operation will be readily understood. Referring, therefore, to Figs. 1, 2, and 3, we will assume the machine to be at rest, with the upper spindles screwed in and the lower spindles screwed out (see Fig. 1) and the chucks D D' empty. A blank will now be inserted in the front jaws of each chuck and the lower chuck immediately turned one-half revolution, so as to bring the lower blank in position before the lower and retired spindles, while the upper chuck is still left unchanged with its blank held in front. The machine is now started, when the upper spindles will screw out and the lower ones screw in, thus forcing the taps into three sides of the blank in the lower chuck and thus properly tapping the openings therein. As soon as the upper spindles have retired far enough to withdraw the taps from the path of the upper chuck, or just as the two sets of spindles arrive at the end of their respective strokes, when the reversal takes place, then the operator turns the upper chuck one-half revolution to bring the blank therein in front of the now retracted taps, in which position the chuck is locked by the bolt *f*, as before. As the upper taps now advance toward and enter the upper blank, the lower taps will screw out of the lower blank,

and while this is taking place the operator can leisurely place a fresh blank in the front jaws of both upper and lower chucks. As soon as the lower taps have retired, then the lower chuck is turned half-way around to bring the blank last inserted in front of the taps, so as to receive their next action, while the blank previously tapped is now brought to the front and may be removed to give place to a third blank. These operations are repeated continually while the machine is working, the operator turning each chuck alternately at the reversal of the spindles and alternately inserting a blank in each, and removing the tapped blanks as fast as they come to the front. It will therefore be seen that by the arrangement shown two three-sided blanks or T's may be tapped on all sides at the same time, and that no time is lost in the operations, and that the chucks are placed in a very convenient position directly in front of the operator and in front of the group of spindles, and that he can leisurely attend to the feed of each chuck without altering his position, and can at the same time easily observe the action of all the taps from his position. These advantages enable many blanks of elaborate forms to be turned out rapidly and with the easy attention of one operator, and besides the machine is of compact form and simple construction. It will now be understood, referring to Figs. 1 and 3, that the clamp-screw of the upper chuck may be easily operated by an ordinary loose hand-wrench applied to the uppermost screw-head. It will be seen, however, that it would not be convenient to operate the screw of the lower chuck by a hand-wrench, as the wrench would have to be inserted between the two chucks and between the standards *e e* in order to grasp the head of the screw, and the limited space would necessitate short strokes and frequent removals and applications of the wrench to tighten the screw, which would be objectionable. I have therefore devised a special wrench device, manipulated at a distance from the chucks, so as to operate the screw of the lower chuck easily and quickly. This device is shown best in Figs. 1 and 3, and consists of a wrench or key spindle, *u*, and a crank-shaft, *v*, rotatively connected with each other by gearing $w\,w'\,w^2$, and reciprocally connected by a lever, *x*. The key-spindle *u* slides vertically through a bore in the bed-plate and between the chuck-standards *e e* in direct line with the head of the chuck-screw, as shown best in Fig. 1, and its upper end is formed with a square cavity adapted to fit over the square head of the chuck-screw in the manner of a watch-key. The lower portion of the key-spindle slides through the hub of the pinion *w*, but is rotatively engaged thereto by a spline, while the lower end of the spindle terminates with a grooved collar, which is engaged by the forked end of the lever *x*, the opposite end of which abuts against the end of the crank-shaft *v*. This shaft, as shown best in Figs. 1 and 2, passes vertically through the bed-plate just on or near the rim *a'*, and its lower end is square (or its equivalent) and passes through the hub of the pinion w^2 and rests on the outer arm of the lever *x*. The weight of the key-spindle *u* is such as to cause it to normally gravitate away from the chuck-screw and out of the path of the chuck, and to thus depress the inner arm of the lever *x* and raise the outer arm and the crank-shaft *v* in the position best shown in Fig. 1. Hence, in the normal position of parts, the lower chuck may be revolved without fouling with the key-spindle *u*. As soon, however, as the chuck is locked in its position by the pin *f*, and it is desired to turn the screw, then the operator seizes the crank of the shaft *v*, and first pressing the same down, thereby raises the key *u*, and engages the head of the chuck-screw, when, by revolving the crank, motion will be imparted through the gearing $w\,w'\,w^2$ to the key-spindle, and the same thereby revolved in the desired direction to loosen or tighten the jaws in an easy and rapid manner, as will be readily comprehended. When the crank is released, the parts will gravitate to their normal positions, as shown, thus forming a very desirable wrench mechanism for the peculiar situation described.

I do not limit myself to the precise rotary and reciprocating connections shown between the key-shaft *u* and the crank-shaft *v*, as any other suitable connection may of course be used without departing from the plan shown.

It will be seen that in Figs. 1, 2, and 3 I have shown the machine as adapted for tapping or threading blanks of three-sided or T-shaped form, but it may be of course used for drilling or reaming, or for other work, by fitting the spindles with the appropriate tools, and where blanks of two-sided or elbow form are to be tapped one of the spindles in each tier may be thrown out of gear, if desired. It will be also noted that the machine which I have illustrated in Figs. 1, 2, and 3 is more especially adapted for tapping or threading work in the rough casting at one operation, or for tapping blanks which have been previously drilled or reamed in this or another machine, in which case it is preferable to have all the spindles arranged in parallel planes, and to use two chucks, one above the other, corresponding to the two tiers of spindles, as described. In case, however, it is desired to ream and tap the work by successive operations in the same machine, then I prefer to arrange the spindles and chuck as indicated in Fig. 4. In this case two tiers of spindles will be used as before, but only one large rotary chuck will be employed, this being common to all the spindles, and rotating on a horizontal axis between but parallel with the planes of the two tiers of spindles and in front of the converging ends thereof. The front spindles, 2 3 5 6, of each tier, which project toward the side of the chuck, will be in parallel planes, as before described, but the two central spindles, 1 4,

which project toward the periphery of the chuck, will be inclined or converged toward the axis of the chuck. It will therefore be seen that by this arrangement when the T or elbow is properly presented to the upper set of spindles it may be there reamed out on all sides by the three spindles, and the chuck may be afterward partially rotated to bring the same T in relation with the lower spindles carrying taps, which will then tap the reamed T while a rough T is brought into relation with the upper or reaming spindles. In this modification all the spindles must be so geared as to advance and return simultaneously, the chuck being shifted after each retreat of the spindle, so as to bring the rough T in relation with the reamers and the reamed T in relation with the taps, and so on repeatedly, the rough T's being inserted successively in the jaws on the top or advancing side of the chuck, while the finished T's are removed from the jaws on the under side of the chuck. This modification of my invention I have illustrated in diagram only, as the preferred construction shown in the leading figures is the most important embodiment of my invention, as it is adapted for the rapid and direct cutting of male or female threads on castings of many-sided angular forms, for which work there is extensive demand in the arts.

It will be noted that in both forms of my invention the spindles are arranged in two tiers, the spindles of each tier converging to a center, and at this center is arranged a rotary chuck rotating on an axis parallel with the spindles, the periphery of the chuck rotating in a plane which is vertical or at right angles to the plane of the spindles. This arrangement I consider preferable; but in the case of Figs. 1, 2, and 3 the chucks might be arranged to revolve on a vertical axis, if desired, without departing from the general plan of my machine. It will be further observed that I have shown the taps as solid and the spindles having a positive screw engagement with fixed nuts, whereby when an alternative reverse rotary motion is imparted to the spindles they will move with a positive screw motion back and forth. In some cases, however, collapsible taps may be used, in which case the spindles may revolve continuously in one direction, while a leading screw and nut will be employed which can be thrown into or out of mesh at any point and the spindles retracted by a spring or its equivalent. This form of screw-feed for taps or reamers being a well-known equivalent for the simple form which I have illustrated, it therefore needs no further elucidation here.

It will be noted that I have shown and described the spindles as being disposed in horizontal planes and the chuck rotating in a vertical plane on a horizontal axis; but it is obvious that the machine might be turned around or on end, so that the present horizontal would become the vertical, &c., without altering the described relation of the parts and without departing from what I consider the essential features of my invention; but such alteration of positions I do not of course recommend, as it would not be desirable.

In the Grinnell machine, before referred to, fixed single-jawed chucks are employed, which render it necessary that both sets of spindles be stopped for a considerable interval of time after the spindles of each retire from the tap-fitting, in order to allow the tapped fitting to be removed and a blank-fitting to be inserted. In my case, however, where double-jawed rotary chucks are employed, mounted one over the other in relation with the two tiers of spindles, it will be noted that no such stoppage in the motion of the spindles is necessary, for at the instant when the motions of the spindles are reversed the rotary chuck carrying the finished fitting may be rotated instantly to bring the next blank-fitting in front of the advancing spindles, while the finished fitting is brought to the front for removal. Each chuck is thus rotated alternately at the moment of reversal of the spindles, and each empty jaw of the last-rotated chuck is filled with a blank-fitting during the subsequent motion of the spindles, as described. Hence, by this combination of two double-jawed rotary chucks mounted one over the other, with two tiers of respectively-converging spindles geared to work in opposite directions, which is novel with me, I produce a double-acting machine, in which there is actually no loss of time, and in which the work produced by it is far greater in quantity than can possibly be produced by any previous machine, while at the same time its operation and management are easy, and the operator has ample time in which to attend to the feeding of the machine, which is not the case with any previous machine.

What I claim as my invention is—

1. In a double-acting boring and threading machine, the combination, with two tiers of two or more spindles, placed one over the other and geared to act in opposite directions, the spindles of each tier converging to a common center, of two double-jawed rotary chucks, mounted one over the other in relation with the respective tiers of spindles, and at the convergence thereof, substantially as and for the purpose set forth.

2. The combination, with a fixed framework, and the two series of tapping-spindles mounted thereon, one series over the other, and arranged to act in reverse order, as set forth, of the fixed chuck-standards *e e*, and the two double-jawed rotary chucks D D′, trunnioned in said standard, one above the other, in line with the respective series of spindles, substantially as set forth.

3. In a duplex boring and threading machine, the combination, with the rotary and reciprocating spindles 1 2 and 3 4, arranged superposed in two tiers converging to work-holding chucks, of the directly-intermeshing spur-wheels *h h* on the spindles of each tier,

and the bevel or miter wheel *i* on the spindle of one tier having its intermeshing bevel or miter wheel *l* geared with the next spindle of the tier, substantially as shown and described.

4. In a boring or threading machine, the combination, with the rotary and reciprocating spindles 1 2 3 4 5 6, arranged in two tiers and converging to a center, of the chucks D D′, arranged at said center, the intermeshing spur-wheels *h h* of said spindles, the gearing *i l r* and *k m r′*, and a driving-shaft imparting motion to said gearing, arranged and operating substantially as and for the purpose set forth.

5. The combination, with the work-holding chuck or chucks located one over the other, and provided with clamp-screws, of the wrench or key spindle *u*, arranged in line with the screw of the lower or inaccessible chuck and normally retired from said screw, with a manipulating device located at a lateral distance from the said screw, and operative connections between said manipulating device and key-spindle for imparting a rotary and reciprocating motion to said key-spindle, substantially as and for the purpose set forth.

6. The combination, with chucks arranged substantially as shown, of the key-spindle *u*, rotary manipulating spindle or crank-shaft *v*, connecting-lever *x*, and suitable gearing or rotating connection between said spindles, arranged and operating substantially as and for the purpose set forth.

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