No. 673,015. Patented Apr. 30, 1901.

L. D. CASTLE.

BORING, REAMING, AND THREADING MACHINE.

(Application filed July 9, 1900.)

(No Model.) 6 Sheets—Sheet 1.

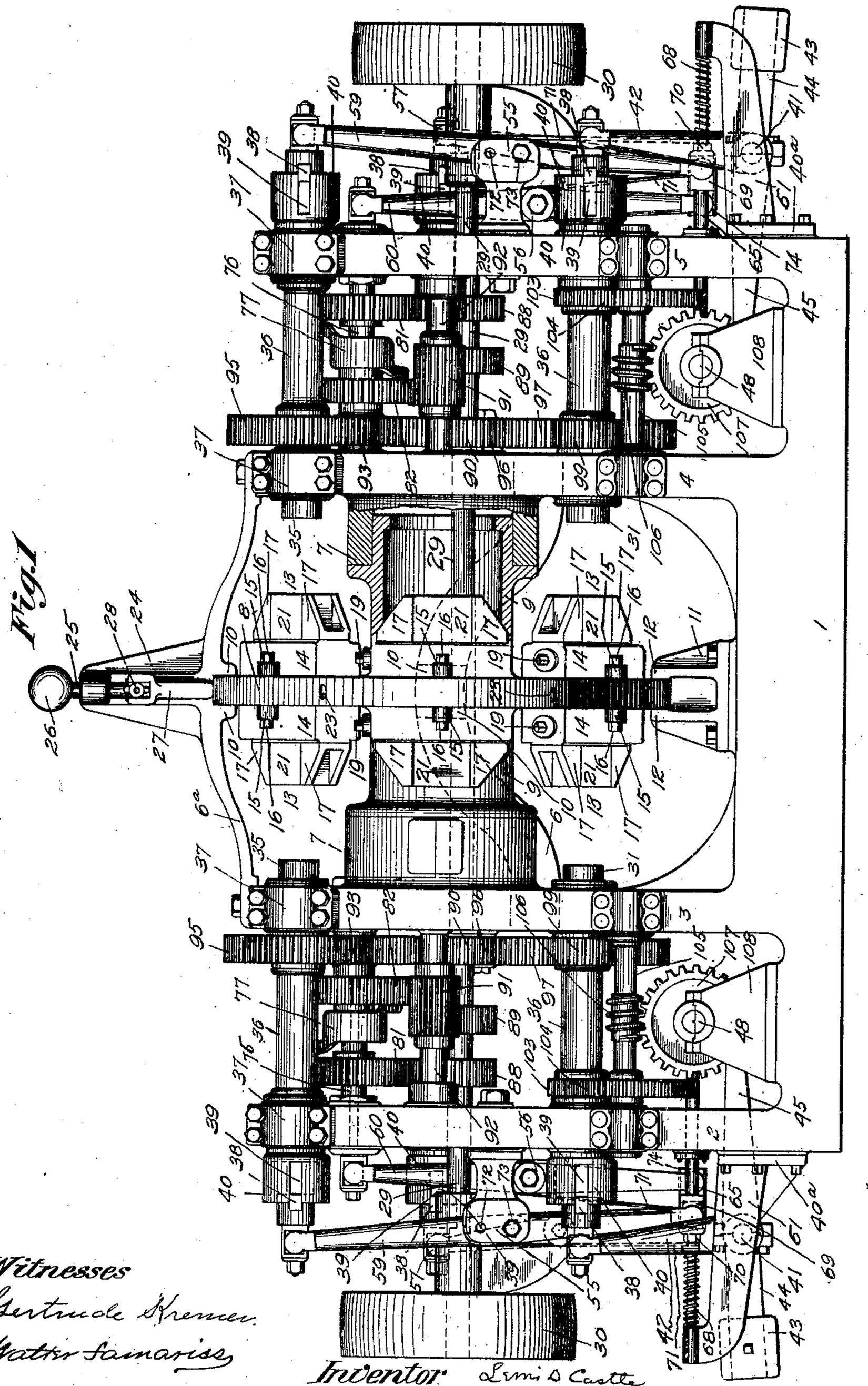


Fig. 1.

Witnesses
Gertrude Kremer
Walter Samariss

Inventor Lewis D Castle
By Munn & Totten Attorneys

No. 673,015. Patented Apr. 30, 1901.

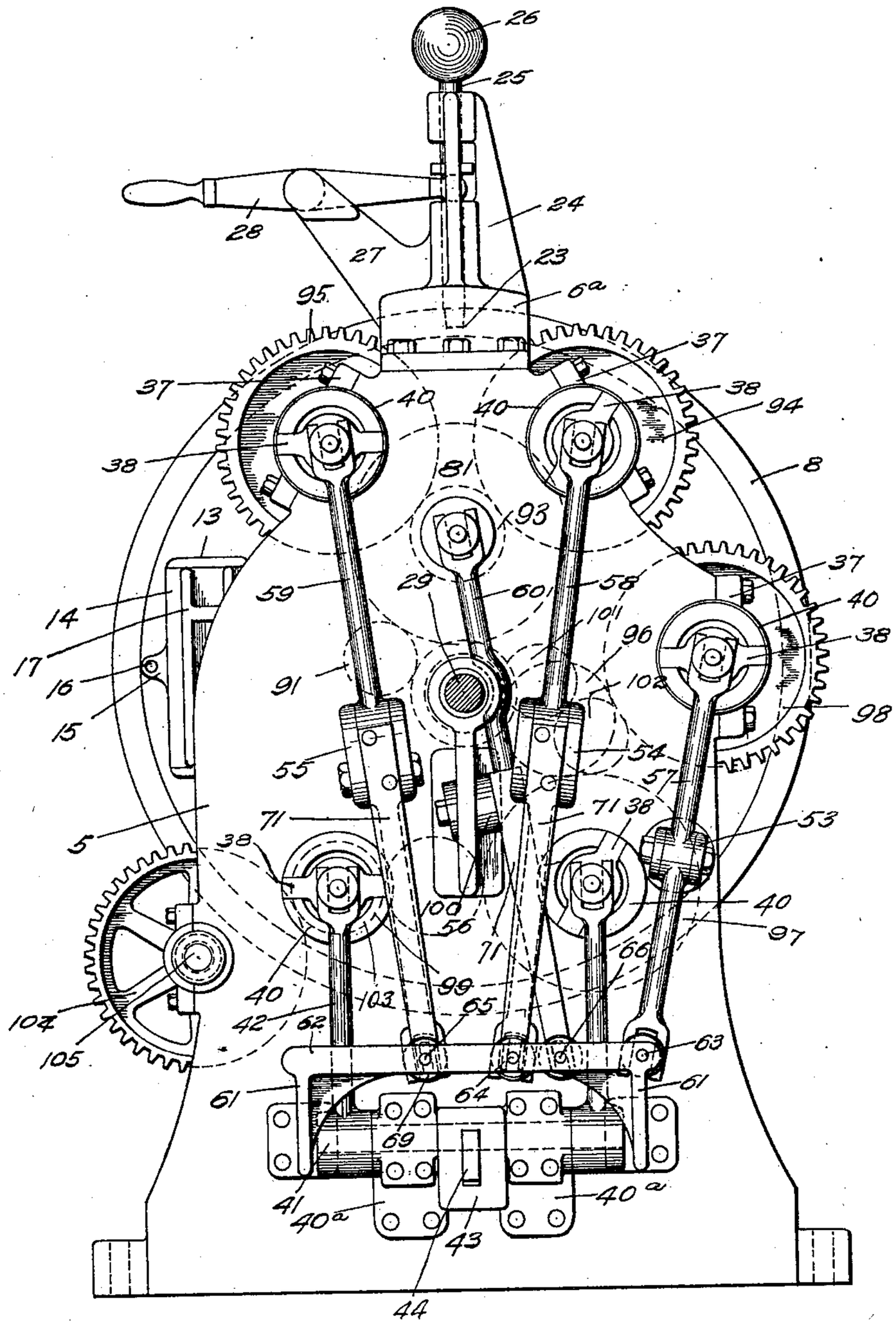
L. D. CASTLE.

BORING, REAMING, AND THREADING MACHINE.

(Application filed July 9, 1900.)

(No Model.) 6 Sheets—Sheet 2.

Fig. 2



Witnesses
Gertrude Kremer
Walter Famariss

Inventor
Louis D Castle
By Kay & Toller
Attorneys

No. 673,015. Patented Apr. 30, 1901.

L. D. CASTLE.

BORING, REAMING, AND THREADING MACHINE.

(No Model.) (Application filed July 9, 1900.)

6 Sheets—Sheet 3.

Fig. 4

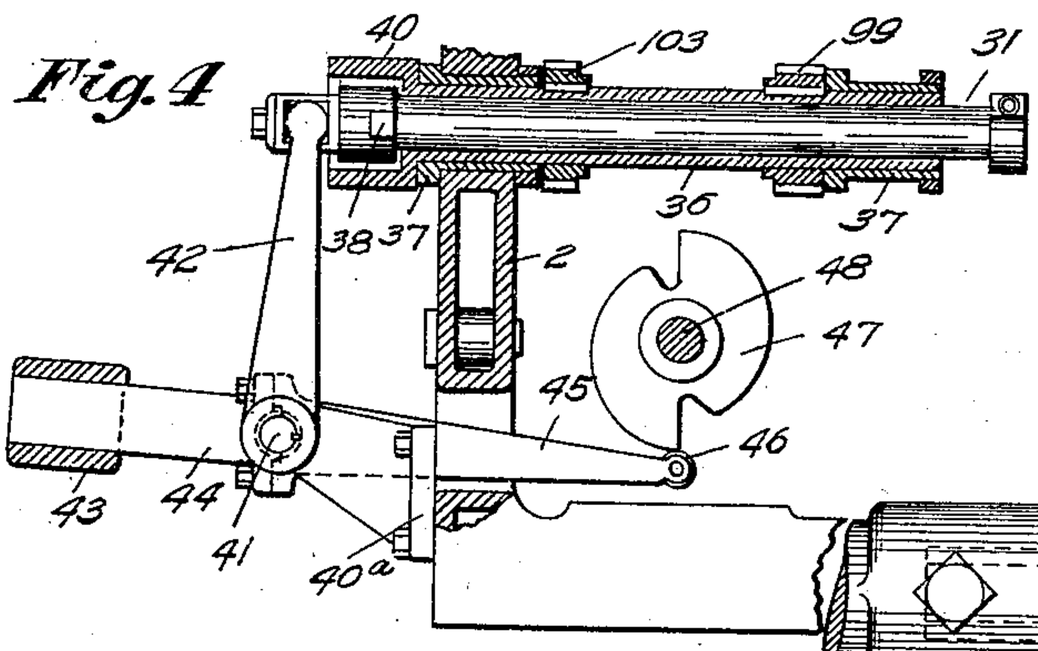


Fig. 5

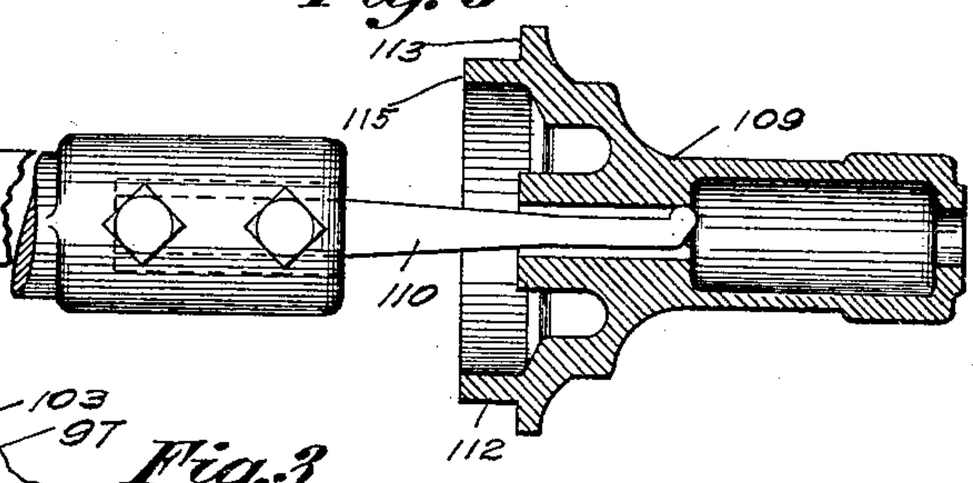


Fig. 3

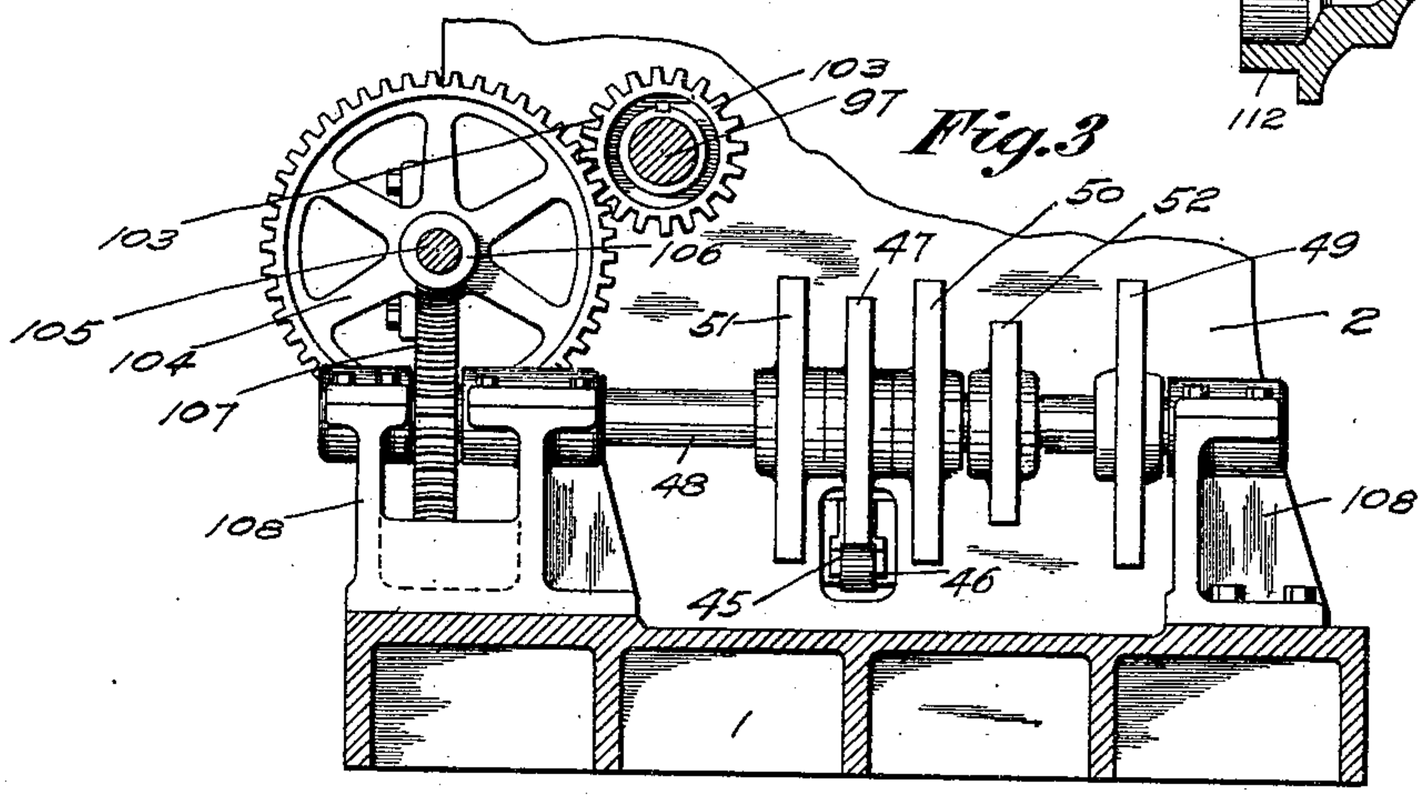
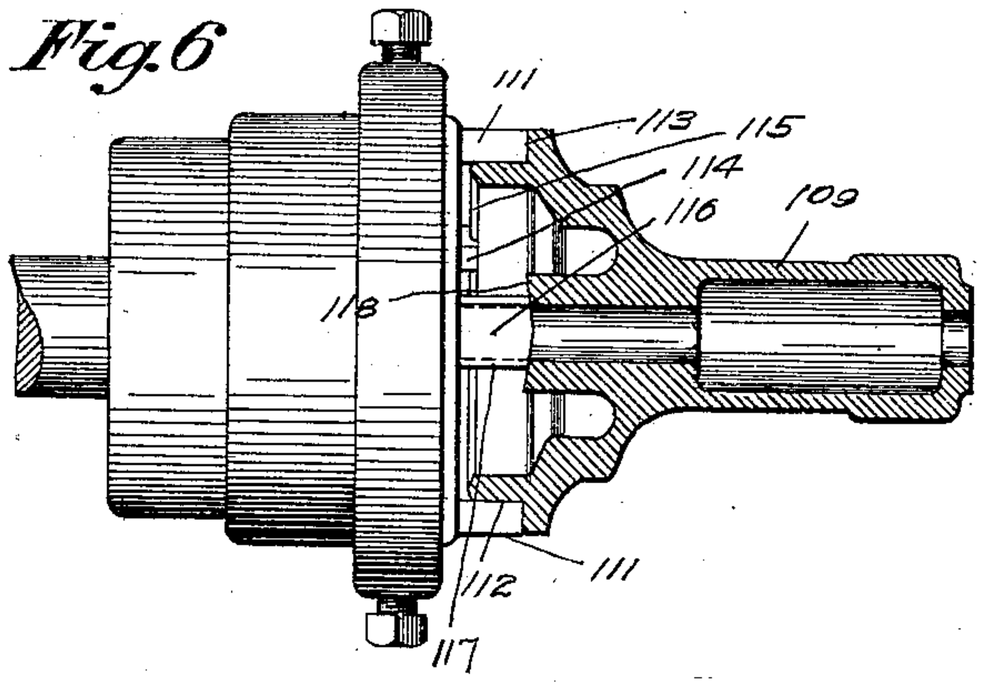


Fig. 6



Witnesses
Gertrude Kremer
Walter Famariss

Inventor
Lewis D Castle
By Kay & Totten
Attorneys

No. 673,015. Patented Apr. 30, 1901.

L. D. CASTLE.

BORING, REAMING, AND THREADING MACHINE.

(Application filed July 9, 1900.)

(No Model.) 6 Sheets—Sheet 4.

Fig. 10

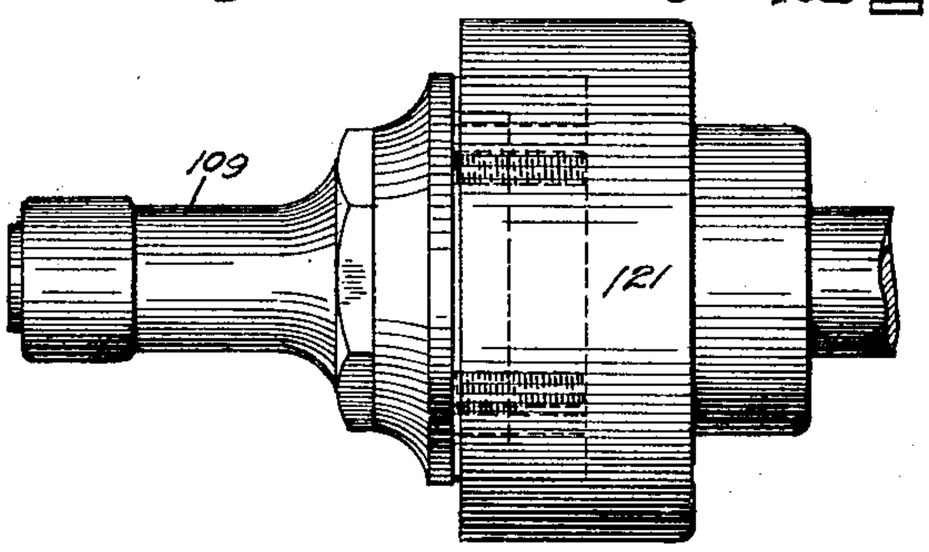


Fig. 8

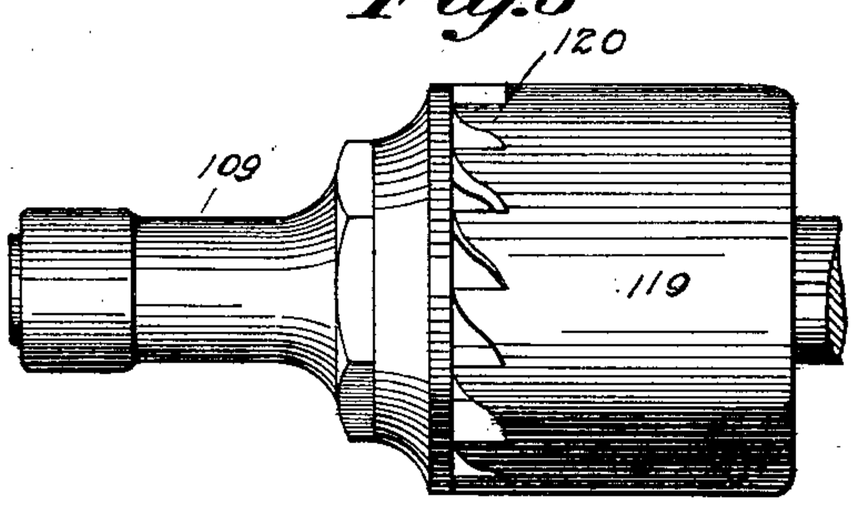


Fig. 9

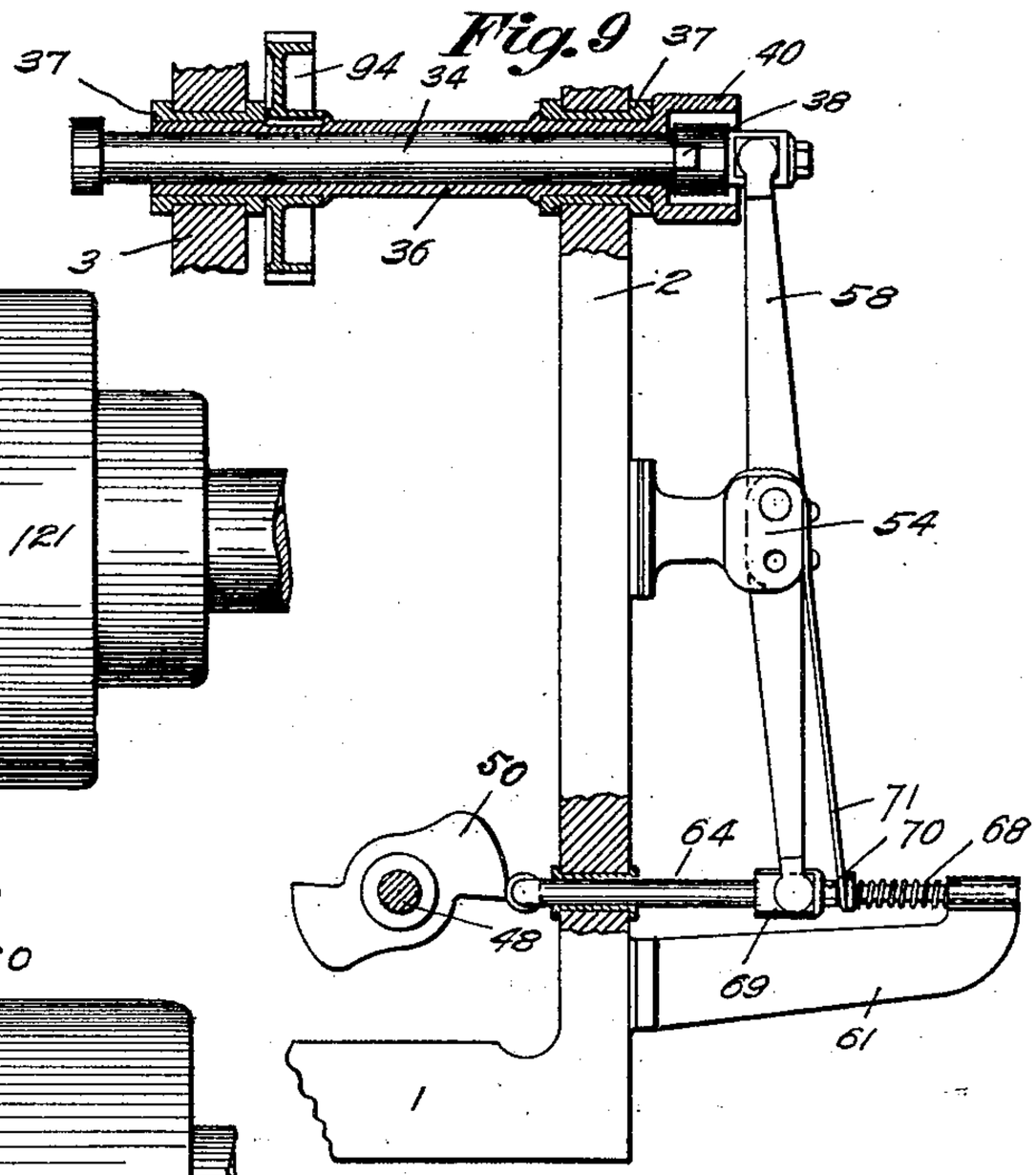
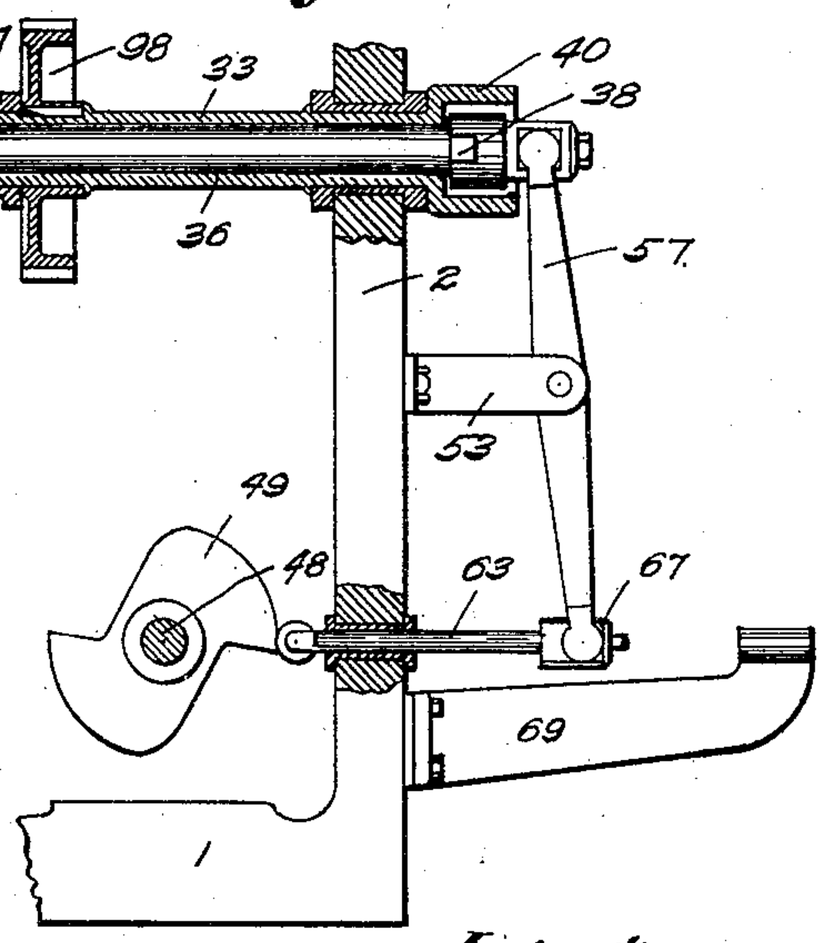


Fig. 7



Witnesses
Gertrude Kremer
Walter Famariss

Inventor
Louis D Castle
By Kay & Totten
Attorneys

No. 673,015.

Patented Apr. 30, 1901.

L. D. CASTLE.

BORING, REAMING, AND THREADING MACHINE.

(No Model.)

(Application filed July 9, 1900.)

6 Sheets—Sheet 5.

Fig. 11

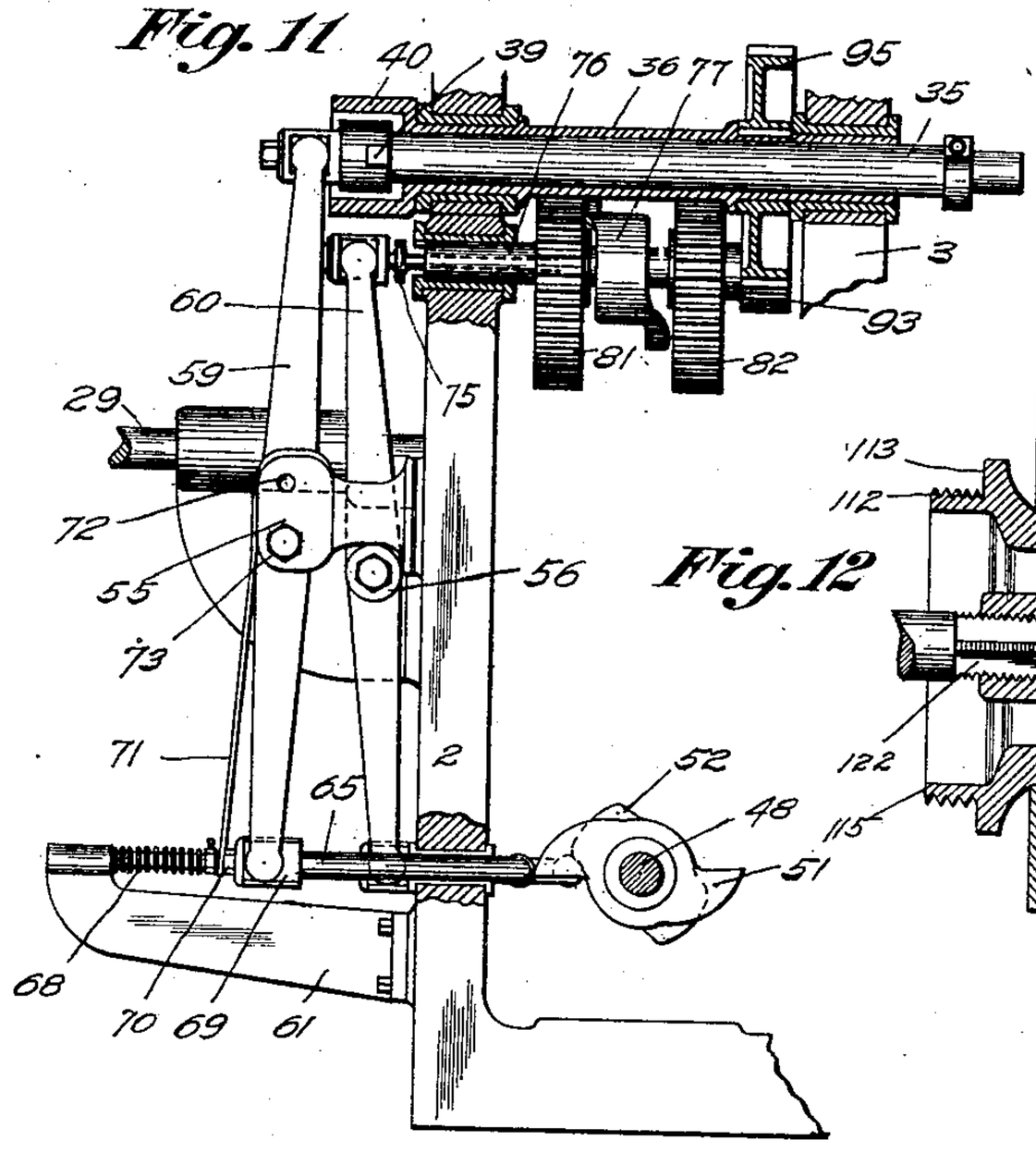


Fig. 12

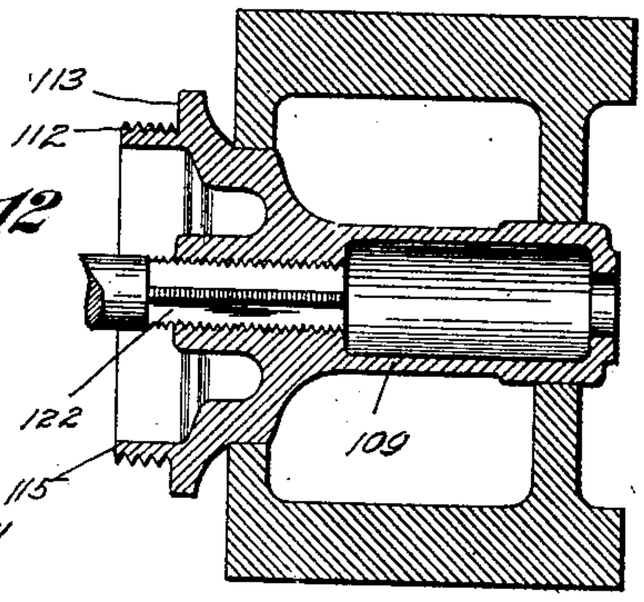
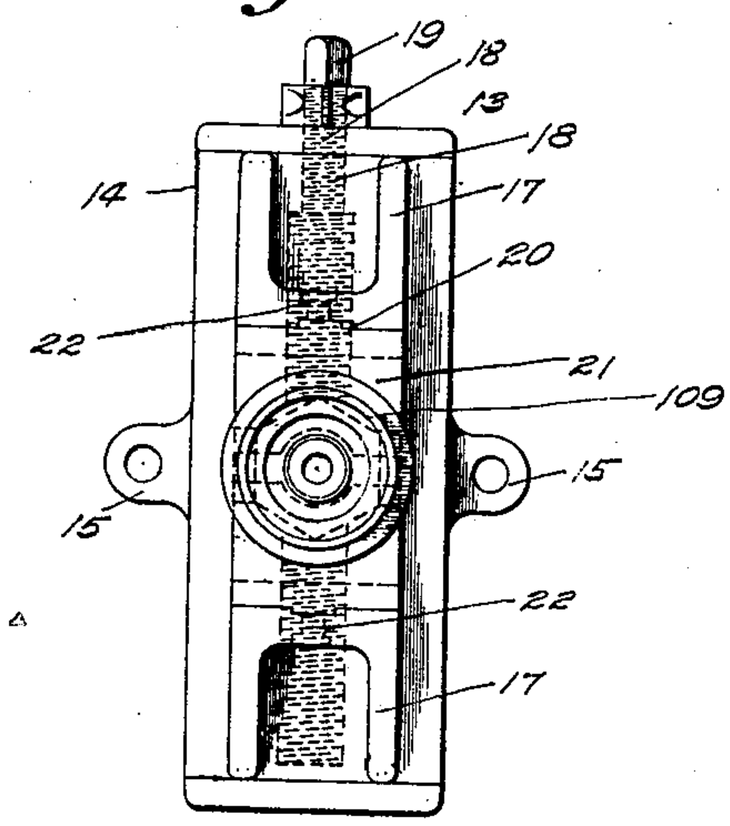


Fig. 13



Witnesses
Gertrude Kremer
Walter Famariss

Inventor
Lewis D Castle
By King & Potter
Attorneys

No. 673,015. Patented Apr. 30, 1901.

L. D. CASTLE.

BORING, REAMING, AND THREADING MACHINE.

(No Model.) (Application filed July 9, 1900.)

6 Sheets—Sheet 6.

Fig. 15

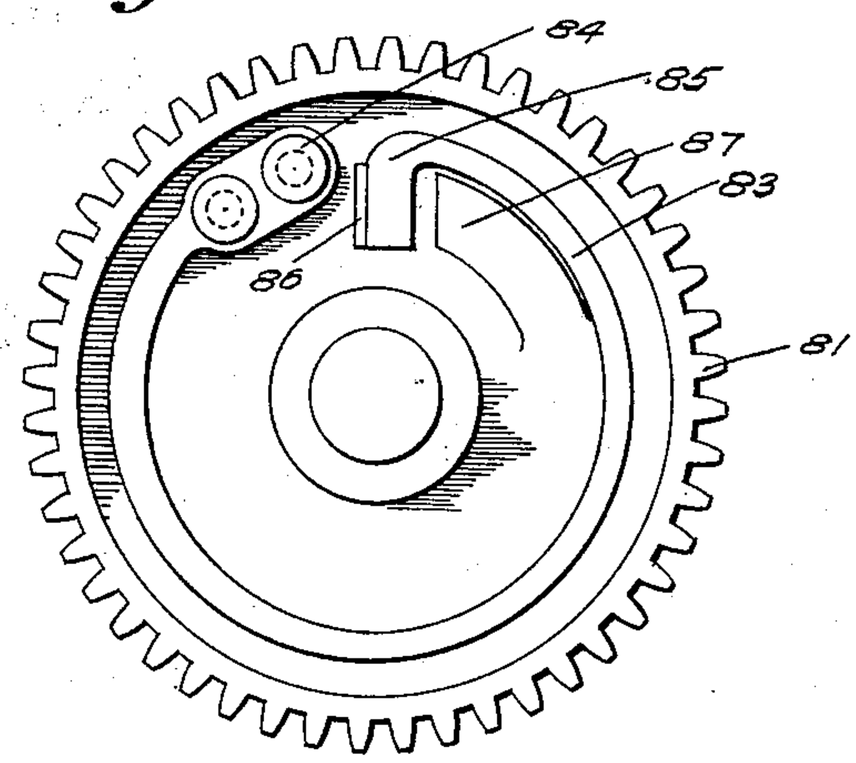


Fig. 16

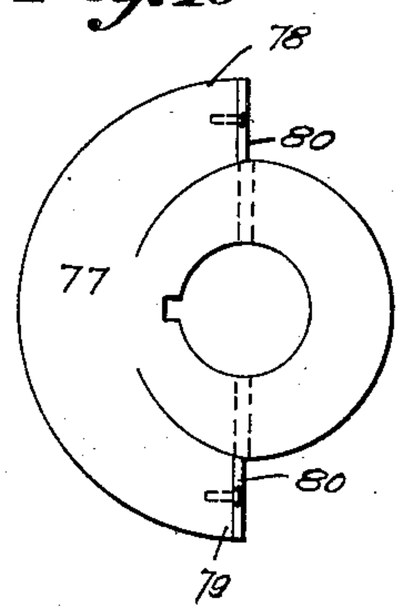
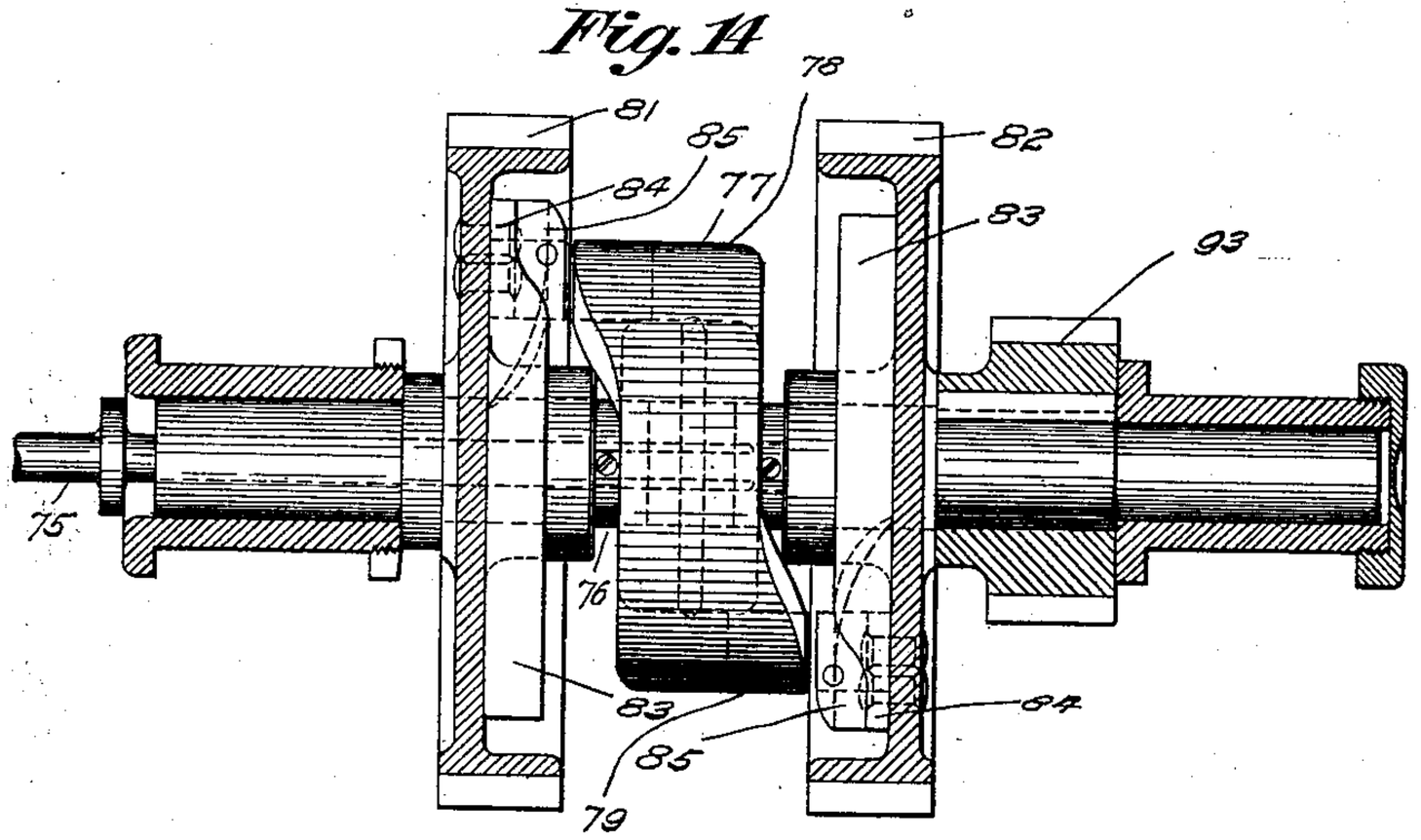


Fig. 14



Witnesses
Gertrude Kremer.
Walter Famariss

Inventor
Lewis D Castle
By Kay & Totten
Attorneys

UNITED STATES PATENT OFFICE.

LEWIS D. CASTLE, OF GREENSBURG, PENNSYLVANIA, ASSIGNOR TO JOHN T. KELLY, OF BROOKLYN, NEW YORK, AND GEORGE M. JONES, OF PITTSBURG, PENNSYLVANIA.

BORING, REAMING, AND THREADING MACHINE.

SPECIFICATION forming part of Letters Patent No. 673,015, dated April 30, 1901.

Application filed July 9, 1900. Serial No. 22,959. (No model.)

To all whom it may concern:

Be it known that I, LEWIS D. CASTLE, a resident of Greensburg, in the county of Westmoreland and State of Pennsylvania, have invented a new and useful Improvement in Boring, Reaming, and Threading Machines; and I do hereby declare the following to be a full, clear, and exact description thereof.

My invention relates to machines for boring, reaming, facing, threading, tapping, or otherwise finishing metal articles and to all machines of this character which perform two or more operations in succession on the article; and it has for one object to provide a machine of this character which is, in effect, a double machine, thereby increasing the number of tool-spindles that a single workman can attend and providing a machine in which articles of different sizes or different character can be operated on at the same time or wherein if articles of the same size are being operated on said articles are firmly held in the chucks.

A further object of my invention is to improve a machine of this character in details of construction, as will hereinafter appear.

All existing forms of machines of this character are provided with either but a single set of tool-spindles or two sets of spindles with a single set or series of chucks corresponding thereto. In the first type of machine the output is limited, as only a single series of articles is operated on at a time, while in the second type of machine the single set or series of chucks makes it necessary that articles of the same kind and size be presented to both sets of tool-spindles simultaneously, and even in that case if any irregularity exists in the articles being operated on only the larger one of said articles will be held firmly by the chuck, the other being loose therein.

An object of my invention is to overcome these defects; and to this end it consists of a machine having two sets of tool-spindles, together with a rotary disk between said sets of spindles, the rotary disk having mounted thereupon on each side thereof a series of chucks, the chucks on one side being wholly independent of those on the opposite side, so that an article of one size or character may be held in the corresponding tool-spindles, while an article of a different size or character may be held in the chucks on the opposite side of the disk and operated on by the tools held in the tool-spindles on that side of the machine.

To enable persons skilled in the art to make and use my machine, I will now describe the same more fully, referring to the accompanying drawings, in which—

Figure 1 is a front elevation of the machine. Fig. 2 is an elevation of the right-hand end of said machine. Fig. 3 is a detail view showing the cam-shaft and its driving means. Fig. 4 is a detail showing the boring or box tool spindle, with the means for feeding it. Fig. 5 is a detail of the boring-tool. Fig. 6 is a detail of the box-tool. Fig. 7 is a detail of the facing-tool spindle, with its feeding means. Fig. 8 is a detail of the box-tool. Fig. 9 is a detail of the threading-die spindle, with its feeding means. Fig. 10 is a detail of the threading-die. Fig. 11 is a detail of the tapping-spindle, with its feeding and reversing mechanism. Fig. 12 is a sectional detail of the chuck and tap. Fig. 13 is a face view of the chuck. Fig. 14 is a sectional detail of the reversing-clutch. Fig. 15 is a face view of one clutch member, and Fig. 16 a side view of the other clutch member.

1 represents the bed of the machine, upon which are erected standards 2, 3, 4, and 5, preferably cast integral with the bed, in which standards are mounted the tool-spindles and driving-gearing hereinafter described. The standards 3 and 4 are connected on the rear side of the machine by the bracket 6 and at the top by the bracket 6^a, and between said standards, mounted in suitable boxes 7 7, is the chuck-carrying disk 8, said disk being cast integral with the hubs or trunnions 9, which are turned down at their outer ends to form journals fitting in the boxes 7 7. The hubs or trunnions 9 are made large and cast hollow, as shown.

Each of the brackets 6 6^a is provided with depending ears 10 10, spaced apart a distance slightly greater than the thickness of the disk 8, said lugs or ears serving to steady the disk and support it against the the side thrust of

the tools. On the bed of the machine, directly below the disk 8, is suitably bolted a bracket 11, having arms 12, extending upward and bearing on opposite sides of the disk 8 to steady the same at this point.

On each side of the disk 8 are secured a series of chucks 13, each series in the particular machine shown consisting of six chucks; but the number may be varied according to the number of operations to be performed on the particular article. Each chuck comprises a base 14, provided with side lugs 15, which are suitably perforated to have passed therethrough and through the disk 8 bolts 16, whereby the chucks are rigidly attached to the disk. Within the base 14 are formed suitable guides in which slide the permanent chuck-jaws 17 17, which are moved toward and from each other by the usual right and left hand screw 18, provided at its upper end with a suitable wrench-receiving head 19. The permanent jaws 17 are provided with grooves 20 for receiving corresponding tongues on the false jaws 21, which are suitably secured to the permanent jaws 17, so as to be readily detached therefrom, as by means of screws 22. By this construction I am enabled to change the false jaws 21 to suit the size or shape of the particular article being operated upon.

The disk 8 is provided on its periphery with notches or sockets 23, six being shown in the present instance; but the number would vary according to the number of chucks borne upon the disk. Integrally cast with the bracket 6^a is a standard 24, through which slides the vertical index-pin 25, said pin being suitably weighted, as at 26, and adapted to normally rest in one of the sockets 23 in the periphery of the disk 8. Projecting forward from the bracket 6 is an arm 27, in the bifurcated upper end of which is pivoted a lever 28, said lever being bifurcated at its rear end and suitably secured to the index-pin 25 for raising the latter out of the recesses 23. Instead of providing the index-pin 25 with a weight it may be given a downward bias by means of a suitable spring, as will be readily understood.

Extending through the machine from end to end is the driving-shaft 29, provided at each end with a pulley 30, said shaft being journaled in the standards 2, 3, 4, and 5 and passing through the hollow trunnions 9 of the disk 8. Suitably journaled in the standards 2 3 are the series of tool-spindles, five being shown in the present instance, together with the necessary shafts and gears for driving the same, and in the standards 4 and 5 are journaled a similar number of tool-spindles and driving-gears. As the spindles and other mechanism at the two ends of the machine are identical except in one minor particular, a description of these parts at one end of the machine will be sufficient for an understanding of the entire machine.

As before stated, in the machine illustrated five tool-spindles 31 32 33 34 35 are provided; but the number of such tool-spindles would depend upon the character of article to be finished in the machine. The spindle 31 carries the boring-tool, the spindle 32 the box-tool, the spindle 33 the facing-tool, the spindle 34 the threading-dies, and the spindle 35 the tap. Each of these spindles is mounted in a sleeve 36, which is journaled in suitable boxes 37, mounted in the standards 2 3, the spindles being free to slide longitudinally in the sleeves 36, but being held to rotate therewith by means of the pins 38, secured to the spindles, said pins entering and sliding in slots 39 in enlargements 40 at the rear end of the sleeves 36. Each of the sleeves 36 has rigidly secured thereto its proper driving-gear, which will be hereinafter described.

Secured to the outside of the standard 2 are the brackets 40^a, in which is mounted the rock-shaft 41, said rock-shaft having rigidly secured thereto the arms 42, which extend upward and are attached at their upper ends to the spindles 31 32, respectively, for moving the latter longitudinally in the sleeves 36, the spindles 31 32 being normally held in their retracted position by means of the counterweight 43 on the end of the arm 44, rigidly secured to the rock-shaft 41. Also secured to the rock-shaft 41 is the arm 45, provided at its inner end with the antifriction-roller 46, which is engaged by the cam 47 on the cam-shaft 48, hereinafter to be described. The cam 47 is so shaped as to move the spindles 31 32 gradually toward the article and allow the spindles to be quickly retracted by means of the counterweight 43, the cam being so shaped as to allow of two complete reciprocations of the spindles 31 32 during a single rotation of the cam-shaft. Also secured on the cam-shaft 48 are the cams 49 50 51 52 for actuating the box-tool spindle, the threading-die spindle, the tapping-spindle, and the reversing-clutch, respectively.

Secured to the outside of the standard 2 are suitable brackets 53, 54, 55, and 56, in which are journaled, respectively, the levers 57, 58, 59, and 60, the levers 57, 58, and 59 being connected at their upper ends to the ends of the spindles 33, 34, and 35, respectively, for reciprocating them in their respective sleeves 36, while the lever 60 is connected at its upper end to the clutch-shifting rod, as will be hereinafter described. Also secured to the outside of the standard 2 are the brackets 61 61, connected by the cross-bar 62, said cross-bar lying opposite the lower ends of the levers 57 58 59 60. Sliding through suitable bushings in the standard 2 are the rods 63, 64, 65, and 66, said rods having rollers at their inner ends bearing against the cams 49, 50, 51, and 52, respectively, and at their outer ends sliding in suitable bearings in the cross-bar 62. Secured to the sliding rod 63 is the sleeve 67, which is secured to the bifurcated lower end of the lever 57, and interposed between said sleeve 67 and the

cross-bar 62 is a spiral spring 68, said spring tending normally to hold the rod 63 in its innermost position, thereby holding the box-tool spindle 33 retracted, said spindle being fed toward the article by the cam 49, said cam being so shaped as to feed the tool toward the article gradually, then hold it in such position for a short interval, and then permit its sudden retraction therefrom by means of the spring 68, said cam permitting two complete reciprocations of the box-tool spindle during a single revolution of the cam-shaft.

Each of the rods 64 65 has loosely sliding thereon a sleeve 69 69, said sleeves being secured to the lower bifurcated ends of the levers 58 59, respectively. Outside of the sleeves 69 on each of the rods 64 65 are fixed the nuts 70 70, between which are held the bifurcated lower ends of stiff plate-springs 71, the upper ends of which are rigidly secured to the levers 58 59, respectively. Between the nuts 70 and the cross-bar 62 are interposed spiral springs 68, as above described, said springs tending to force the rods 64 65 inward, thereby holding the spindles 34 35 retracted. The inner ends of the rods 64 65 are provided with anti-friction-rollers which bear against the cams 50 51, respectively, said cams being so shaped as to feed the spindles 34 35 toward the article gradually and permitting their sudden retraction therefrom by means of the springs 68, said cams permitting two complete reciprocations of these spindles during a single revolution of the cam-shaft. The spindles 34 35 carry the threading-die and the tap, respectively, and inasmuch as the die and the tap must be varied to cut screw-threads of different pitches it is necessary to so construct the mechanism for feeding forward the spindles during the threading and tapping operations as to compensate for the differences in the pitch of the screw-threads. This I accomplish by providing the brackets 54 55 with two holes 72 73, and the levers 58 59 may have their pivot-bolts inserted in either of said holes. For cutting fine screw-threads the pivot-bolts pass through the holes 72, thereby getting a slow inward feed of the spindles 34 35. If it is desired to cut screw-threads of a greater pitch, the pivot-bolts of the levers 58 59 are passed through the holes 73, thereby getting a more rapid inward feed of the spindles 34 35. For cutting screw-threads intermediate the fine and the coarse pitch I depend upon the feeding action of the die and tap themselves, the difference between the feed of the cams 50 51 and the die and tap, respectively, being compensated for by the yielding connection between the levers 58 59 and the rods 64 65 which is provided by the springs 71, before described.

The rod 66 has at its inner end an antifriction-roller which bears against the double cam 52, said rod having secured thereto a sleeve 74, to which is secured the bifurcated lower end of the clutch-shifting lever 60, said rod 66 being provided with a spiral spring 68, interposed between the sleeve 74 and the cross-bar 62, as in the case of the rod 63. The upper end of the clutch-shifting lever 60 is secured to the rod 75, which slides in a suitable bore in the clutch-shaft 76 and is attached at its inner end to the clutch member 77, the clutch-shaft 76 being suitably slotted to allow a pin to pass therethrough to secure the clutch member 77 to the rod 75 and permit a sliding movement of these parts on the shaft 76. The clutch member 77 is provided with two diametrically opposite faces 78 79, which are provided with suitable wearing-plates 80, the faces 78 79 lying on opposite sides of the middle line of said member 77, as will be readily apparent from Figs. 11 and 14. The clutch-spindle 76 is suitably journaled in the standards 2 and 3 and has running loosely thereupon, on opposite sides of the clutch member 77, two spur-gears 81 82, each of said gears being provided on its face adjacent the clutch member 77 with a spiral spring 83, said spring having one end suitably secured to the web of the gear, as at 84, and having its outer end bent, as at 85, said bent end being provided with the wearing-plate 86 for receiving the impact of the clutch-face 78 or 79 of the member 77. Back of the bent end 85 of the spring 83 the web of the gears 81 82 are provided with the shoulders 87, against which the bent ends of the springs 83 are adapted to bear. By this construction when the clutch member 77 is thrown into engagement with either of the gears 81 or 82 the clutch-face 78 or 79 comes in contact with the wearing-plate 86 of the spring 83 and said spring yields until the bent end 85 thereof comes in contact with the shoulder 87, thereby preventing shocks to the machine in the reversing operation.

The driving-shaft 29 has keyed thereto three spur-gears 88, 89, and 90, the gear 88 meshing with the gear 81 on the clutch-spindle, while the gear 82 meshes with an idler-pinion 91 on the counter-shaft 92, suitably mounted in the standards 2 and 3, said idler 91 meshing with the gear 82 on the clutch-spindle. It will be observed that by this mechanism the gears 81 82 on the clutch-spindle are being constantly driven, but in opposite directions, so that the clutch-spindle will be driven in either one or the other direction, according as the clutch member 77 is in engagement with the gear 81 or the gear 82. Rigidly secured to the clutch-spindle is a pinion 93, which is in engagement with the spur-gears 94 and 95, mounted on the sleeves 36 of the spindles 34 35, respectively, said spindles 34 35 therefore being driven in unison and in the same direction and reversed simultaneously, as will be readily understood.

The spur-gear 90 on the driving-shaft 29 meshes with an idler-gear 96, mounted on a stud on the standard 3, said idler-gear 96 meshing with gears 97 98 on the sleeves 36 of the spindles 32 33, respectively, these spin-

dles therefore being rotated in the same direction and at the same speed, but being unaffected by the reversing mechanism above described. On the sleeve 36 of the spindle 31 is secured a spur-gear 99, which meshes with an idler 100, journaled on a suitable stud secured to the standard 3, said idler 100 meshing with the gear 97 before described, so that the spindle 31 is driven in the same direction as the spindle 32, but at a higher speed.

The only modification in the driving-gearing existing between the two opposite ends of the machine resides in this: At one end of the machine there is a single idler 96 intermediate the driving-shaft 29 and the gears 97 98 of the spindles 32 33, while at the opposite end of the machine two such idlers 101 102 are placed between the driving-shaft and the gears 97 98. The object of this is to have the spindles 31 32 33 at the opposite ends of the machine driven in the same direction, so that it will not be necessary to make right and left hand boring-tools, box-tools, and facing-tools; but these tools may be used interchangeably on either end of the machine.

Also secured on the sleeve 36 of the spindle 31 is a spur-gear 103, which meshes with a spur-gear 104, secured to the shaft 105, suitably mounted in the standards 2 and 3, the shaft 105 having thereon the worm 106, which meshes with a worm-wheel 107, secured to the cam-shaft 48, said cam-shaft being mounted in suitable brackets 108, secured to the bed of the machine.

The machine as shown and described is adapted for finishing bonnets for valves, and the different operations performed thereon are shown in Figs. 5, 6, 8, 10, and 12. The bonnet 109 is first bored out by means of the boring-tool 110, disclosed in Fig. 5, and then being turned down by the box-tool disclosed in Fig. 6. The box-tool is provided with the cutter 111 for turning down the face 112 and roughing off the face 113, the cutter 114 for finishing off the edge of the flange at 115, the reamer 116 for reaming the bore of the bonnet to the proper size, and the tool 117 for finishing the face 118. The facing-tool 119, Fig. 8, is provided with a series of cutting-teeth 120, which smooth down the face 113, which has been roughly finished by the cutter 111 in the preceding operation. The threading-die 121, Fig. 10, may be of any ordinary construction and cuts screw-threads on the face 112. The tap 122 cuts screw-threads in the bore of the bonnet, as shown in Fig. 12.

The operation of the machine is as follows: The valve-bonnets or other articles being operated upon are placed two at a time in the chucks 13, carried on opposite sides of the disk 8, the disk 8 being rotated by hand step by step to bring the chucks opposite the various tools in succession. It will be observed that the disk 8 is provided with six pairs of chucks, whereas there are shown but five pairs of operating-tools. This leaves one pair of chucks without operating-tools, this pair of chucks being the one at the front of the machine, and it is in this position of the chucks that the bonnets are placed therein and removed therefrom. The operator after placing a pair of bonnets or other articles in the two chucks at opposite sides of the disk 8 at the front of the machine pulls down on the lever 28, thereby drawing the indexing-pin 25 from the socket 23 in the periphery of the disk 8. Then by hand he rotates the disk 8 in a downward direction and immediately releases the lever 28, the counterweight of the indexing-pin throwing the latter into the next socket 23 of the disk. In this position the valve-bonnets or other articles are in position to be operated upon by the boring-tools carried by the spindles 31. The cams on the cam-shaft are so arranged that at this time they advance the various tools toward the chucks, each tool performing its designed operation on the valve-bonnet or other article, and when said operation is completed the tools are retracted by the springs 68. The operator having placed another pair of articles in the next pair of chucks again rotates the disk 8 forward another step, thereby carrying the articles forward to the next succeeding tool, and so on continuously. The tools are automatically fed forward and retracted by the mechanism heretofore described, the clutch member 77 being alternately shifted into engagement with the wheels 81 82, so as to drive the tap and dies to cut the screw-threads on the bonnet or other article, and then to reverse the tap and die to back them out.

By having the two series of chucks on the opposite faces of the disk 8 independent of each other it is possible to hold the articles securely, irrespective of any irregularities that may exist therein. It is also possible to finish an article of one size or kind on one side of the machine and an article of an opposite size or kind on the opposite side of the machine. I have therefore, in effect, provided a double machine which can be attended to by a single workman, which is adapted to operate upon similar or dissimilar articles simultaneously, and in which the article-holding chucks of the two sets of spindles are moved forward and indexed by a single mechanism.

In the specific machine shown five sets of tool-spindles are shown; but it is within the scope of my invention to use any number of tool-spindles in each set, providing said number is two or more, and with the machine shown it is possible to finish expeditiously articles which require the operation of but two tools. In that case the article would be operated upon by tools carried by any two spindles. The remaining spindles might be disconnected or would merely run idle, the article remaining in the chucks in a finished

state until they came opposite the front of the machine, when they would be removed. The character of tools carried by the various spindles 31, 32, 33, 34, and 35 may be varied according to the article operated upon, and my invention is not limited to any particular kind or kinds of tools.

It will be further observed that the indexing means for the disk 8 is located on the periphery of said disk and outside of the article-holding chucks, so that if any error should occur in the sockets 23 or indexing-pin 25 said error instead of being exaggerated at the chucks would be reduced, as will be readily understood.

What I claim, and desire to secure by Letters Patent, is—

1. In a machine of the character specified, the combination with two sets of tool-spindles, of the movable carrier between said sets of spindles, and two independent series of chucks on said carrier.

2. In a machine of the character specified, the combination with the two sets of tool-spindles, of the carrier between said sets of spindles, two independent series of chucks on said carrier, and means for indexing said carrier.

3. In a machine of the character specified, the combination with two sets of tool-spindles, of the rotary disk between said sets of spindles, and a series of chucks on each side of said disk.

4. In a machine of the character specified, the combination with two sets of tool-spindles, of the rotary disk between said sets of spindles, a series of chucks on each side of said disk, and means for indexing said disk.

5. In a machine of the character specified, the combination with two sets of tool-spindles, of the rotary disk between said sets of spindles, a series of chucks on each side of said disk, and the indexing device for said disk engaging the same outside the chucks.

6. In a machine of the character specified, the combination with the threading-tool spindles, of means for driving the same, said means including a reversing-clutch, one member of which is yielding.

7. In a machine of the character specified, the combination with the threading-tool spindle of means for driving the same, said means including a reversing-clutch, one member of which is provided with a yielding abutment adapted to engage the fixed abutment of the other member.

In testimony whereof I, the said LEWIS D. CASTLE, have hereunto set my hand.

LEWIS D. CASTLE.

Witnesses:

ROBERT C. TOTTEN,

F. W. WINTER.