No. 736,792. PATENTED AUG. 18, 1903.

C. E. SEARCH & E. CHESHIRE.

TURRET LATHE.

APPLICATION FILED SEPT. 3, 1901.

NO MODEL. 8 SHEETS—SHEET 1.

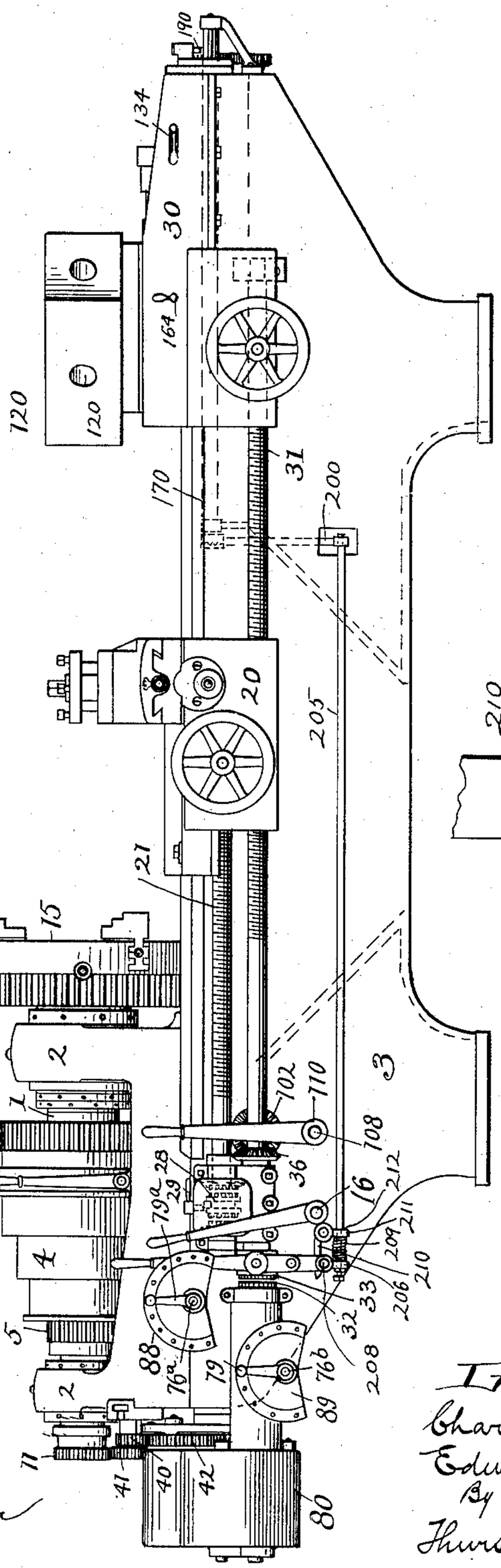


Fig. 1.

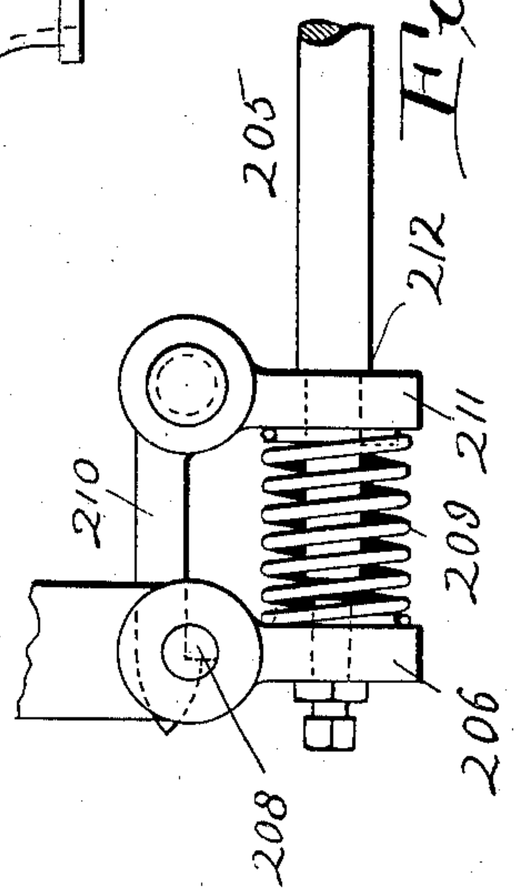


Fig. 2.

Witnesses.
E. B. Gilchrist
Nora V. Brennan

Inventor:
Charles E. Search
Edward Cheshire
By their attorneys
Thurston & Bates

No. 736,792. PATENTED AUG. 18, 1903.

C. E. SEARCH & E. CHESHIRE.

TURRET LATHE.

APPLICATION FILED SEPT. 3, 1901.

NO MODEL. 8 SHEETS—SHEET 2.

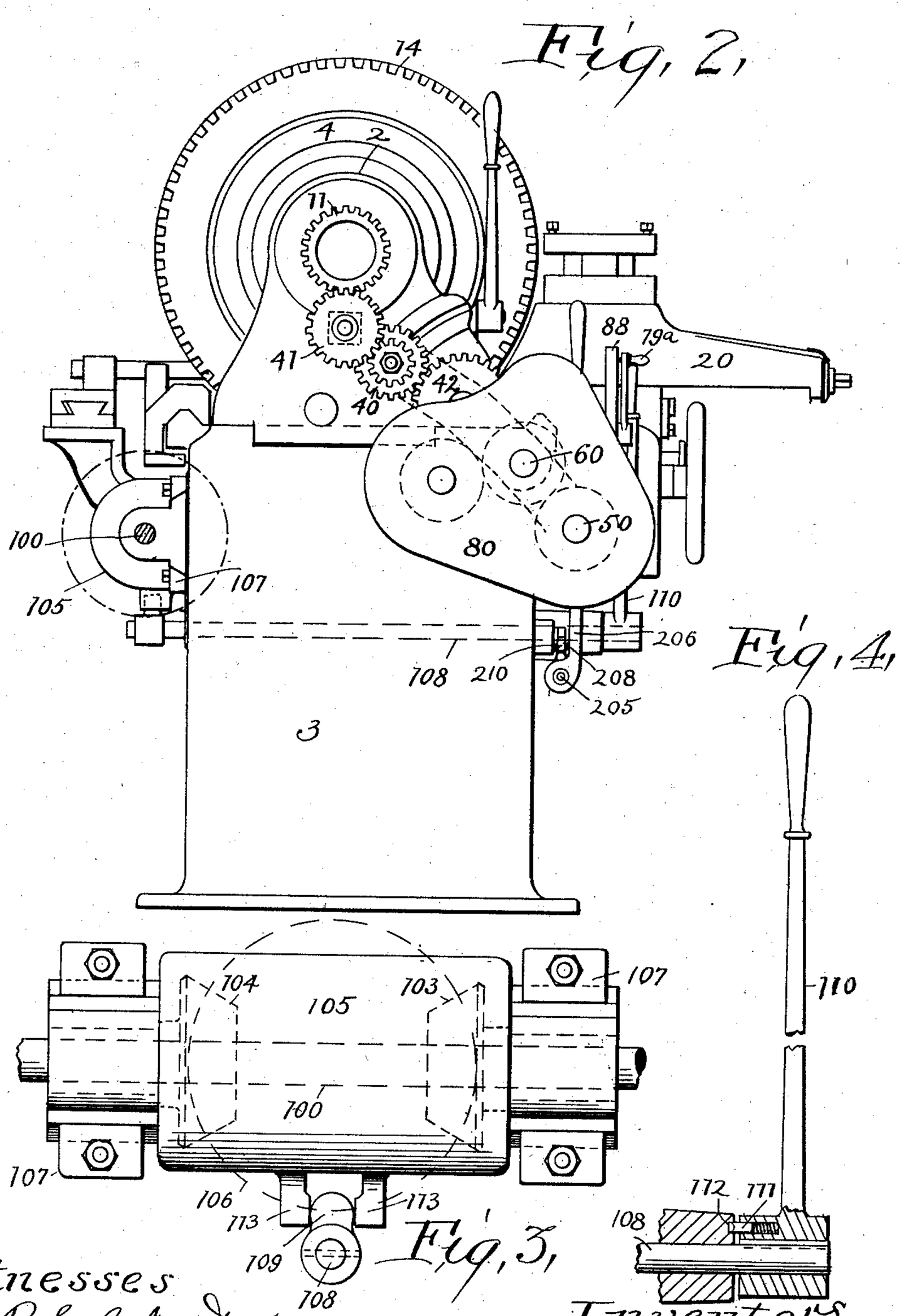


Fig. 2.

Fig. 4.

Fig. 3.

Witnesses
E. B. Gilchrist
Nora Brennan

Inventors
Charles E. Search
Edward Cheshire
By their attorneys
Thurston & Bates

No. 736,792. PATENTED AUG. 18, 1903.

C. E. SEARCH & E. CHESHIRE.

TURRET LATHE.

APPLICATION FILED SEPT. 3, 1901.

NO MODEL. 8 SHEETS—SHEET 3.

Fig. 5.

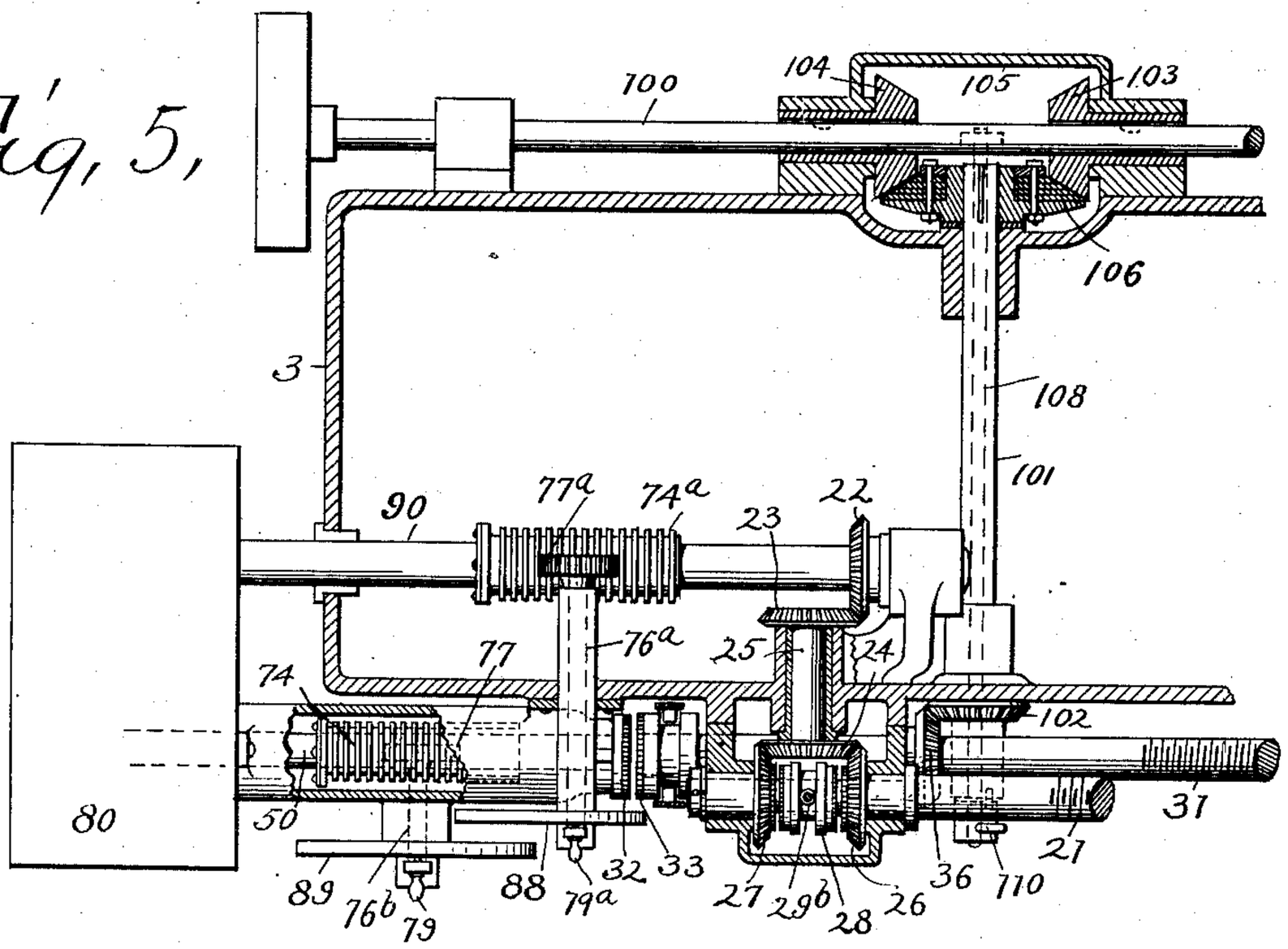


Fig. 8.

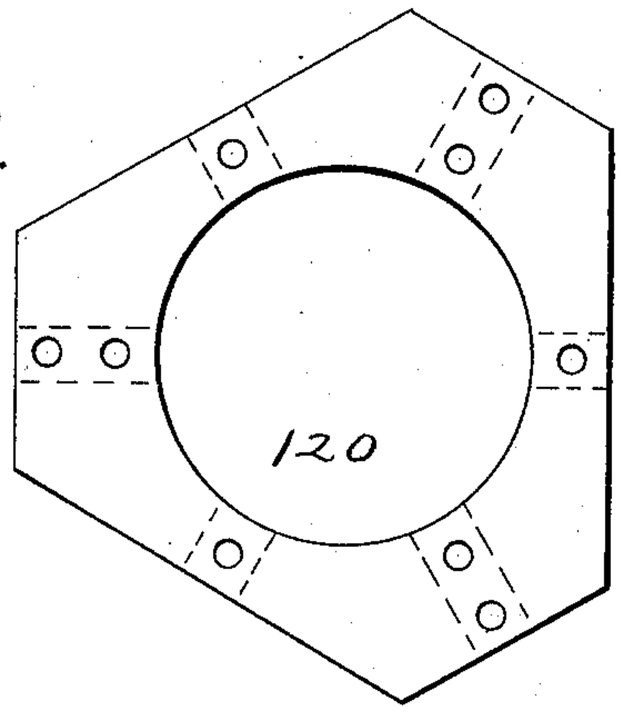


Fig. 19

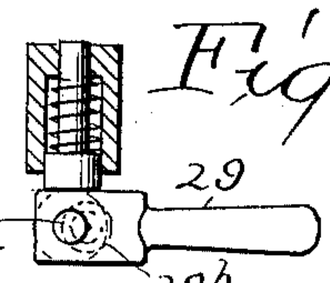
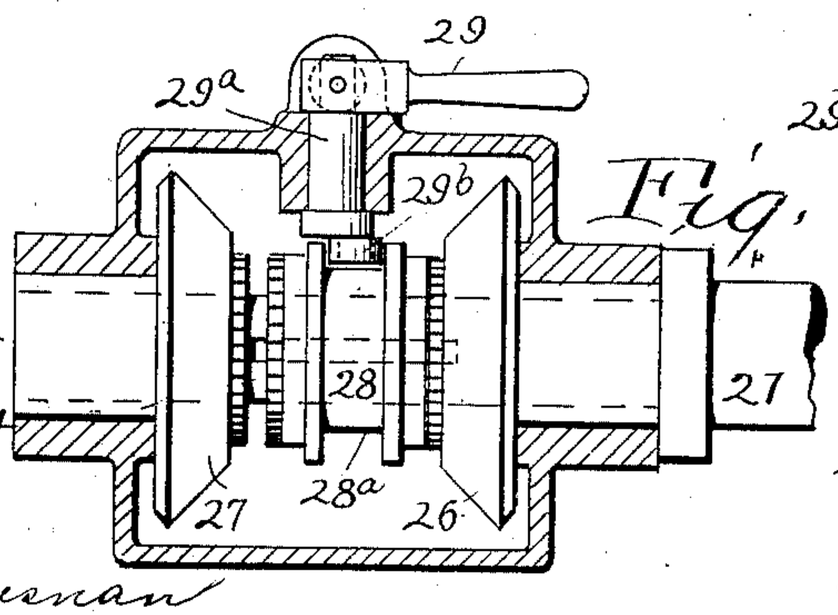


Fig. 18.a



Witnesses
E. B. Gilchrist
Nora Brennan

Inventors
Charles E. Search
Edward Cheshire
By their attorneys
Thurston & Bates

No. 736,792. PATENTED AUG. 18, 1903.

C. E. SEARCH & E. CHESHIRE.

TURRET LATHE.

APPLICATION FILED SEPT. 3, 1901.

NO MODEL. 8 SHEETS—SHEET 4.

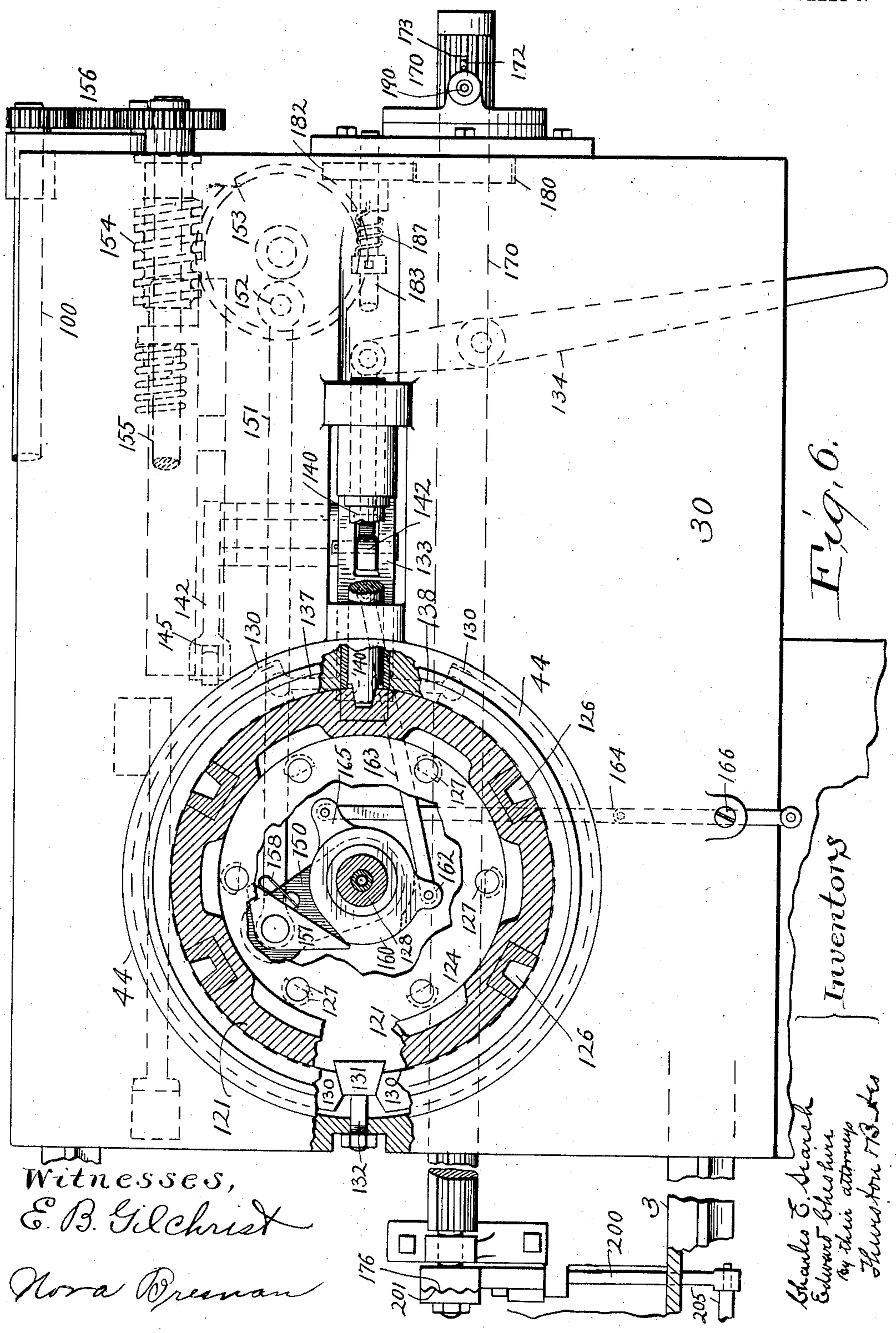


Fig. 6.

Witnesses,
E. B. Gilchrist
Nora Brennan

Inventors
Charles E. Search
Edward Cheshire
by their attorneys
Thurston & Co

No. 736,792. PATENTED AUG. 18, 1903.

C. E. SEARCH & E. CHESHIRE.

TURRET LATHE.

APPLICATION FILED SEPT. 3, 1901.

NO MODEL. 8 SHEETS—SHEET 5.

Fig. 1.

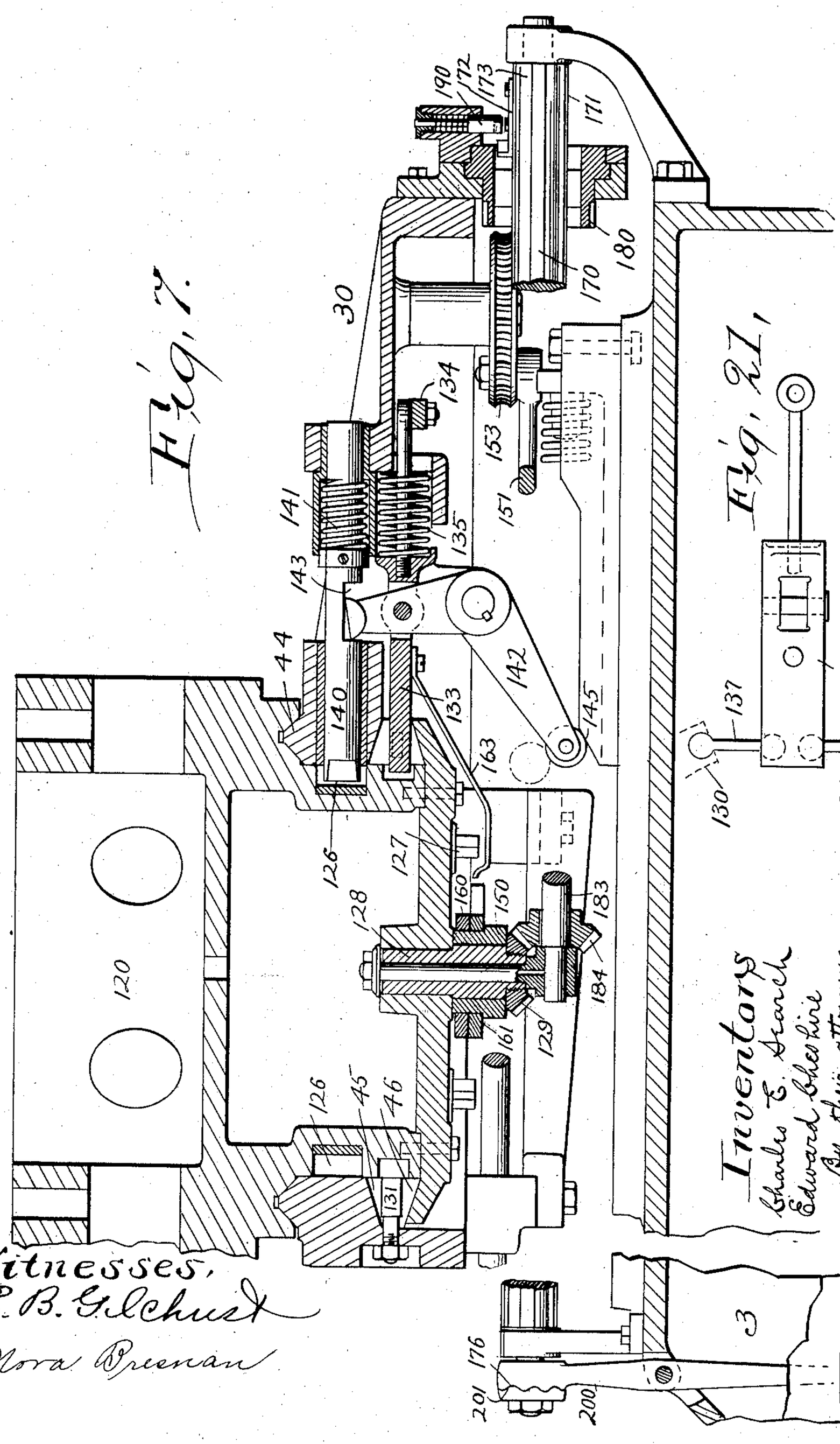


Fig. 2.

Witnesses.
E. B. Gilchrist
Nora Brennan.

Inventors
Charles E. Search
Edward Cheshire
By their attorneys
Thurston & Bates

No. 736,792. PATENTED AUG. 18, 1903.

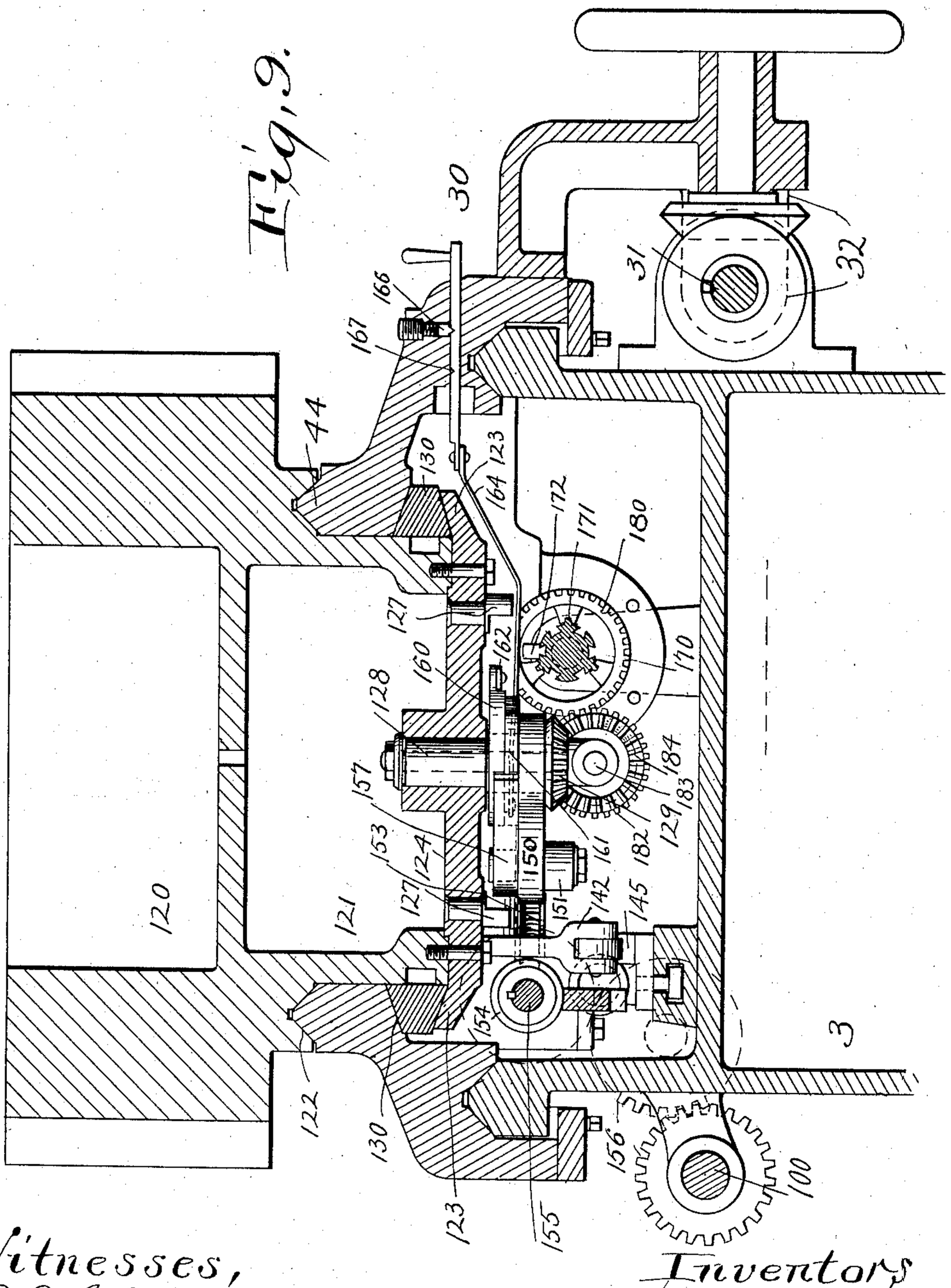
C. E. SEARCH & E. CHESHIRE.

TURRET LATHE.

APPLICATION FILED SEPT. 3, 1901.

NO MODEL. 8 SHEETS—SHEET 6.

Fig. 9.



Witnesses,
E. B. Gilchrist
Nora Brennan

Inventors,
Charles E. Search
Edward Cheshire
By their attorneys
Thurston & Bates

No. 736,792. PATENTED AUG. 18, 1903.

C. E. SEARCH & E. CHESHIRE.

TURRET LATHE.

APPLICATION FILED SEPT. 3, 1901.

NO MODEL. 8 SHEETS—SHEET 7.

Fig. 10

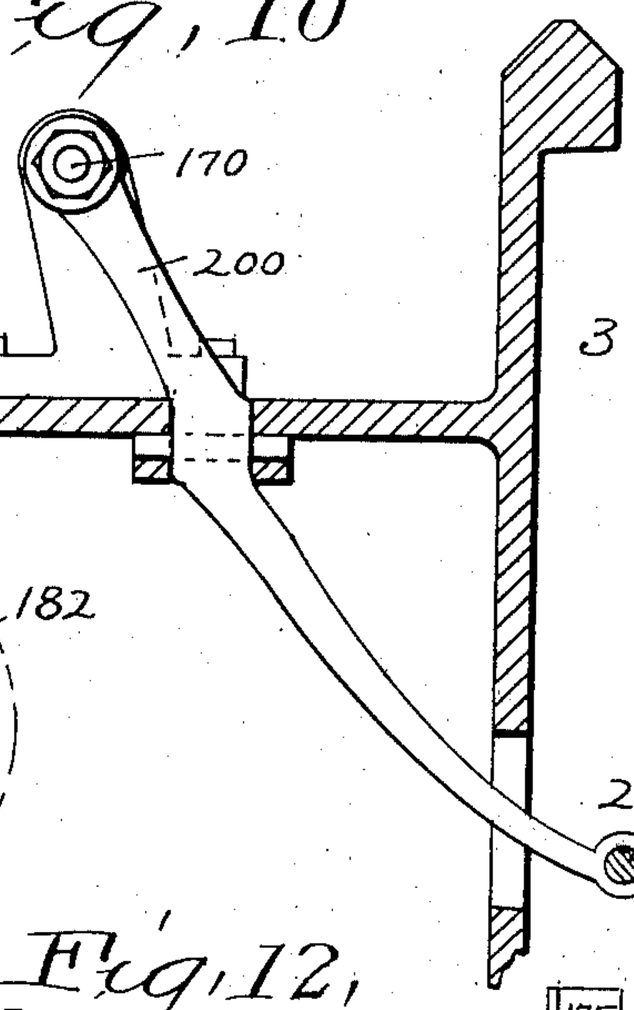


Fig. 18.

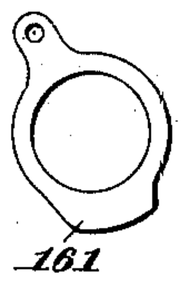


Fig. 11.

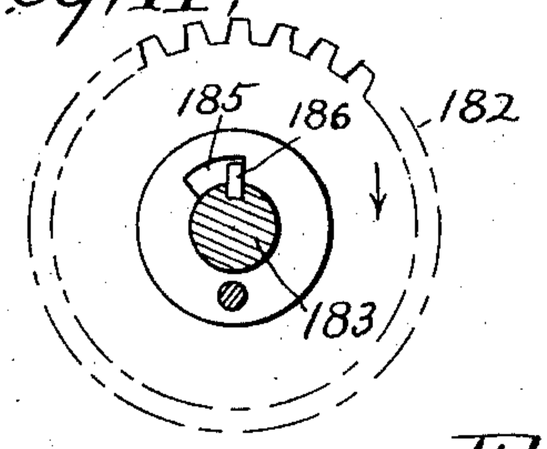


Fig. 12.

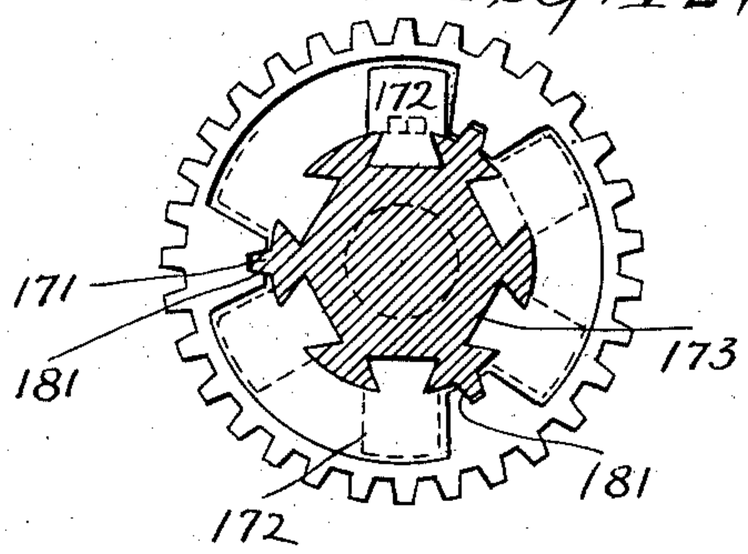


Fig. 14.

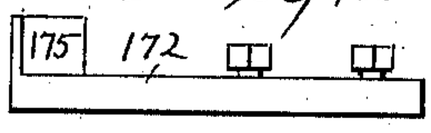


Fig. 15

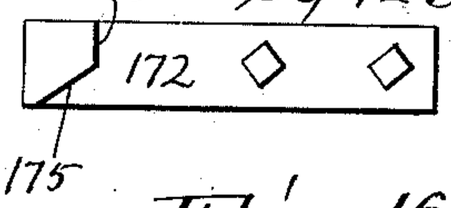


Fig. 16

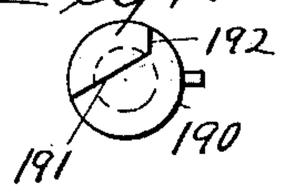


Fig. 13.

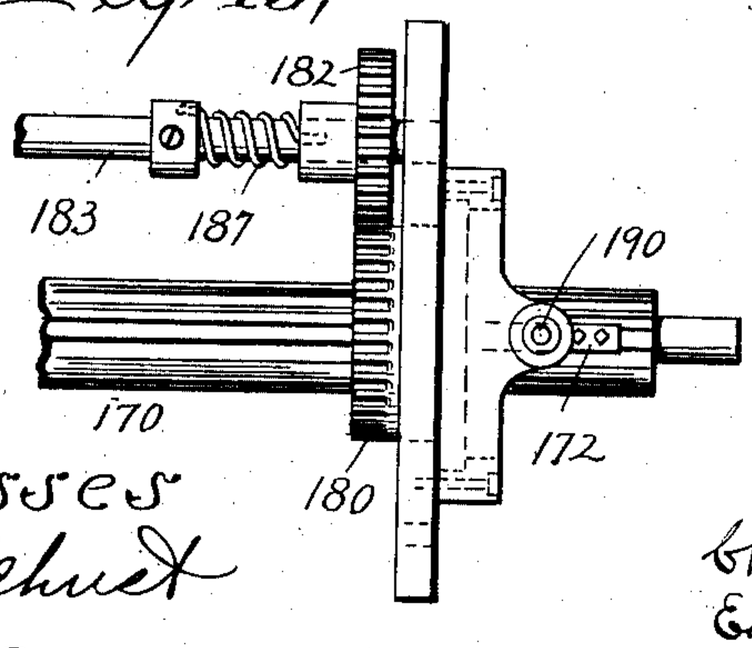
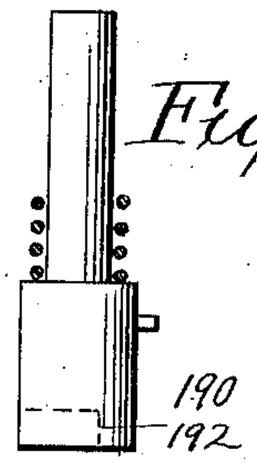


Fig. 17.



Witnesses
E. B. Gilchrist
Nora Brennan

Inventors.
Charles E. Search
Edward Cheshire
By their attorneys
Thurston & Bates

No. 736,792. PATENTED AUG. 18, 1903.

C. E. SEARCH & E. CHESHIRE.

TURRET LATHE.

APPLICATION FILED SEPT. 3, 1901.

NO MODEL. 8 SHEETS—SHEET 8.

Fig 22,

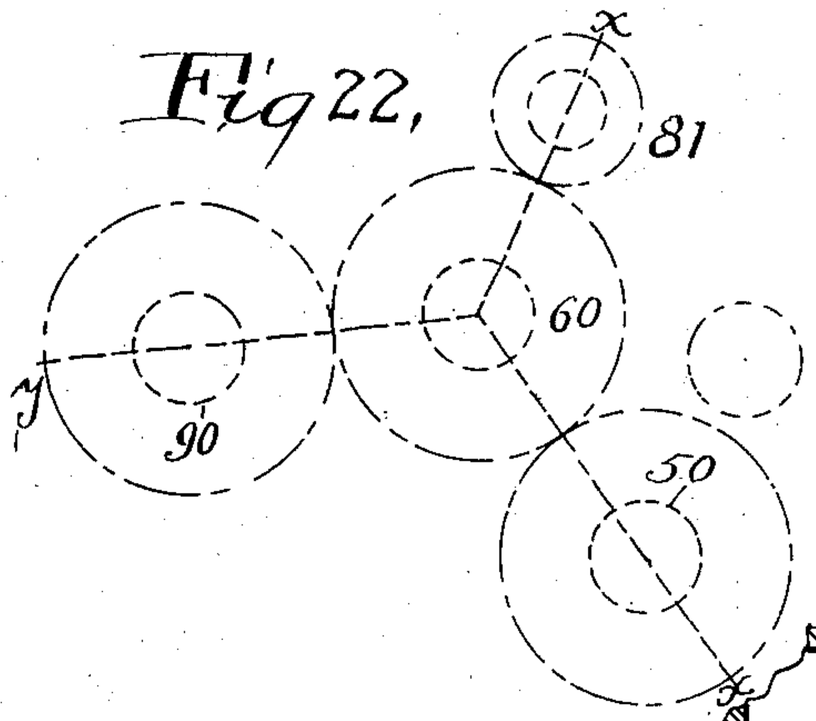
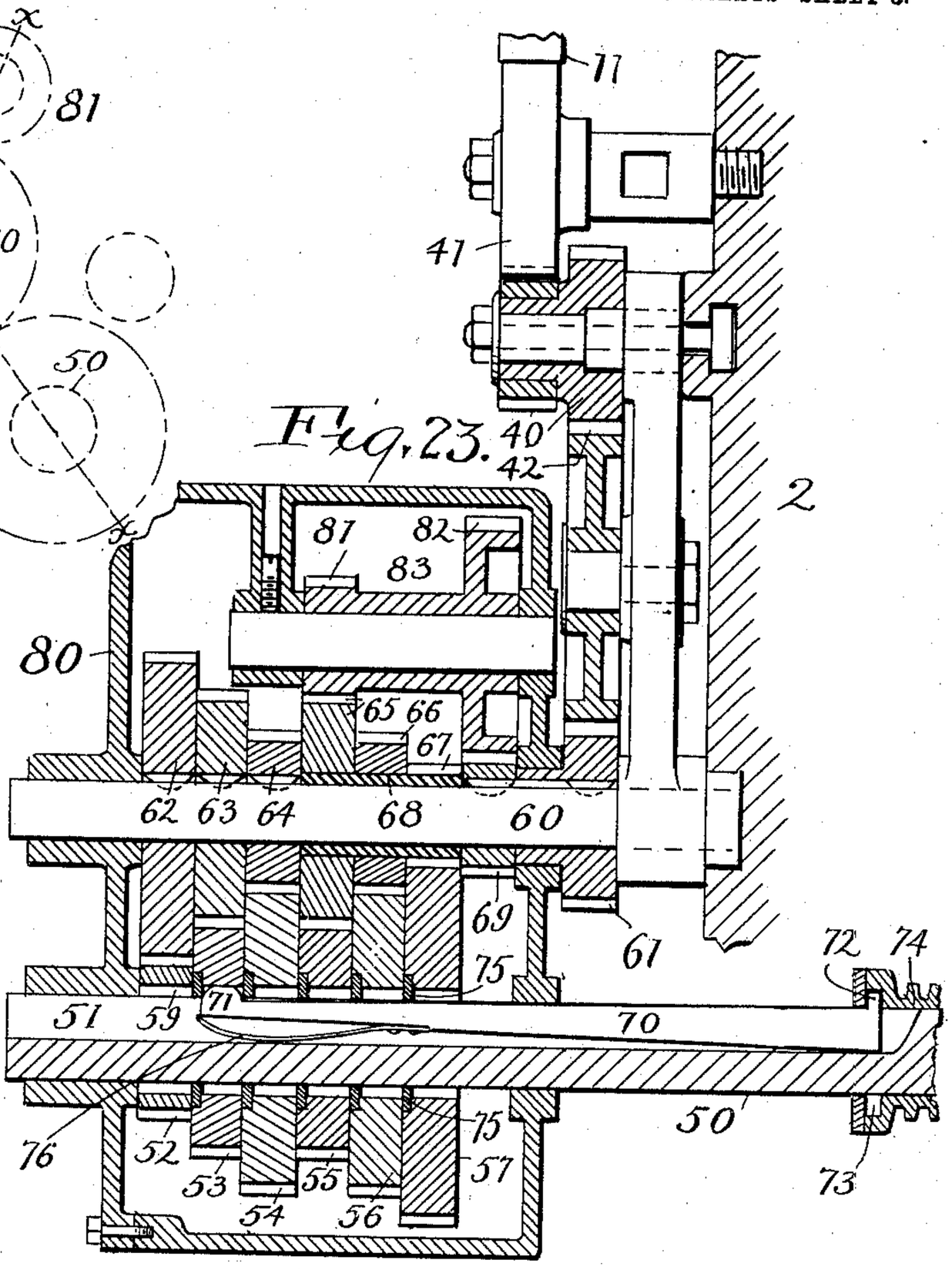
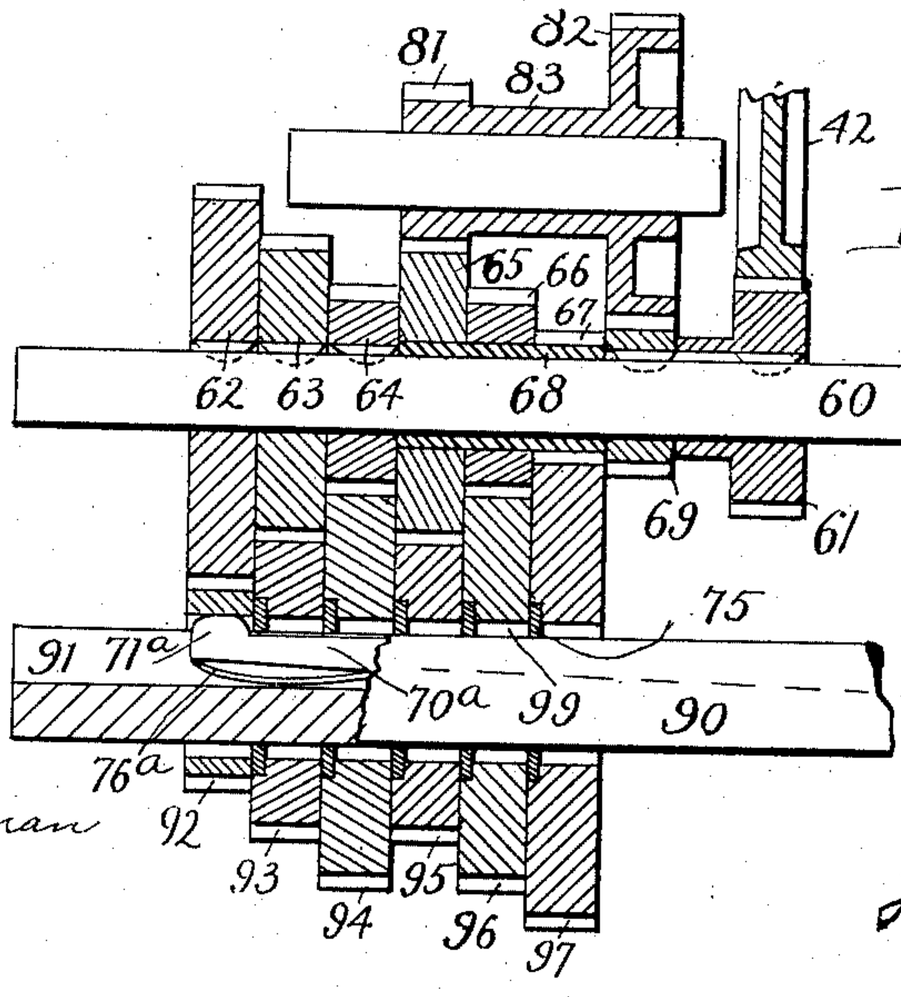


Fig. 23.



Fig, 24,



Witnesses,
E. B. Gilchrist
Nora Brennan

Inventors
Charles E. Search
Edward Cheshire
By their attorneys
Thurston & Bates

No. 736,792. Patented August 18, 1903.

UNITED STATES PATENT OFFICE.

CHARLES E. SEARCH AND EDWARD CHESHIRE, OF MILWAUKEE, WISCONSIN, ASSIGNORS TO MILWAUKEE MACHINE COMPANY, OF MILWAUKEE, WISCONSIN, A CORPORATION OF WISCONSIN.

TURRET-LATHE.

SPECIFICATION forming part of Letters Patent No. 736,792, dated August 18, 1903.

Application filed September 3, 1901. Serial No. 74,080. (No model.)

To all whom it may concern:

Be it known that we, CHARLES E. SEARCH and EDWARD CHESHIRE, citizens of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented a certain new and useful Improvement in Turret-Lathes, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings.

The invention has to do with various parts of a turret-lathe, and particularly with the speed-gearing for the feed-screws of the tool-carriage and turret-slide, respectively, with the turret and its operating mechanism, and with the automatic stop mechanism of the turret-slide, the object being to improve such mechanisms with respect to their constructions, mode of operation, and the results which they produce when acting either independently or in coöperation with one another.

The invention consists in the construction and combinations of parts hereinafter described, and pointed out definitely in the claims.

In the drawings, Figure 1 is a front elevation of a turret-lathe embodying our invention. Fig. 2 is an end elevation from the head-stock end of the machine. Fig. 3 is a rear view of the sliding box which supports the friction-wheels on the rear shaft 100. Fig. 4 is a view of the rock-shaft and operating-lever by means of which said box is moved, said view being partly in section. Fig. 5 is a plan view of various shafts and their connections, the frame of the machine by which said shafts are supported being in horizontal section. Fig. 6 is a plan view with the parts broken away of the turret-slide and parts associated therewith. Fig. 7 is a vertical longitudinal section showing the turret-slide and associated mechanism. Fig. 8 is a plan view of the turret. Fig. 9 is a transverse vertical sectional view of the same parts. Fig. 10 is a detail view of the lever which is operated by the stop-shaft. Fig. 11 is a sectional end view of the shaft 183 and a gear 182 thereon. Fig. 12 is a transverse section of the grooved stop-shaft. Fig. 13 is an enlarged front elevation of the rear end of the stop-shaft and some of the associated mechanism. Figs. 14 and 15 are respectively a side view and a plan view of the adjustable tappets which are secured to the stop-shaft. Figs. 16 and 17 are respectively an end view and an elevation of the pin carried by the slide for cöoperation with such tappets. Fig. 18 is a plan view of the automatic cam 161. Fig. 18^a is a longitudinal vertical section through the clutch mechanism connecting the speed-driven shaft and the feed-screw 21. Fig. 19 is a plan view, partially in section, of a lever 29 and its associated parts. Fig. 20 is an enlarged front elevation of the means for automatically connecting the clutch-operating rod 205 with the lever 206. Fig. 21 is a plan view of the toggle for spreading the clamping-ring 120 and the mechanism for operating said toggle. Fig. 22 is a diagrammatical end view of the nests of gears inclosed in the gear-casing at the head-stock end of the machine. Fig. 23 is a sectional view upon the line $x\,x$, passing through the shaft centers; and Fig. 24 is a sectional view on line $x\,y$ in Fig. 22.

The spindle 1 is rotatably mounted in the head-stock 2 on the frame 3 of the machine. Rotatably mounted upon the spindle is the usual cone-pulley 4, which has as many faces as desired. The spindle 1 is provided with gears 5, 9, and 11, and also with a face-plate 15, which has a suitable gear 14 secured to the back thereof. The gears 5 and 9 are connected with any suitable form of change-speed gearing, which connects with the gear 14. The gear 11 meshes with a gear 41, connected with a gear 40, meshing with a gear 42. These gears are arranged to drive change-speed gearing carried in the casing 80.

The lathe contains a carriage 20, movable longitudinally on ways, which carriage is moved by a feed-screw 21, and the machine also includes a turret-slide 30, movable upon ways upon the machine-frame by a feed-screw 31.

It is desirable to be able to independently vary the speed of the carriage and of the turret-slide, and to this end means are provided for varying the speed at which the two feed-screws operating the same may rotate. The power for rotating said feed-screws is derived

from the gear 11 on the spindle 1, from which it is transmitted through a train of gears 40, 41, and 42 to a pinion 61, fast to the change-gear driving-shaft 60. On this driving-shaft is a nest of gears consisting of three gears 62, 63, and 64, keyed to said shaft, said gears being of different diameters, and also of three other gears 65, 66, and 67, fast to a sleeve 68, rotatably mounted upon said shaft, said last-mentioned gears being of different diameters also. The six gears just described mesh with two series of gears respectively associated with the two feed-screw shafts 50 and 90. Fig. 23 shows the nests of gears associated with the turret-slide-feed-screw shaft 50, and Fig. 24 shows the nest of gears associated with the carriage-feed-screw shaft 90. Six gears 52, 53, 54, 55, 56, and 57 (shown in Fig. 23) are rotatably mounted on the shaft 50, and each meshes with its respective gear on the speed-gear driving-shaft 60, as shown in said figure. The shaft 50 is provided with a groove 51, in which a key-bar 70 is located, said bar having an upwardly-projecting key 71, adapted to project beyond the periphery of the shaft and engage notches 59 in said gears, which are loosely mounted upon said shaft. This key-bar has at its other end a projection 72, entering a groove 73 provided in a sleeve 74, slidably mounted upon said shaft. A spring 76, lying between the extreme end of said lever below said key 71, forces the same outward from said groove into a position where it may engage in any of the notches referred to. Within the casing 80, which incloses these nests of gears, are two gears 81 and 82 of different diameters connected together by a suitable sleeve 83. One of these gears meshes with the pinion 69, fast to the change-gear driving-shaft 60, while the other meshes with one of the gears fast to the sleeve 68, which rotates upon said shaft. The slidable sleeve 74, by which the key 70 is operated, may be circumferentially grooved, thereby giving to it the characteristic of a rack, with which a pinion 77 (shown in dotted lines in Fig. 5) may engage for sliding said sleeves 74, and thereby the key 70 may be caused to engage with any one of said gears upon the shaft 50. Washers 75 between the gears insure the centering of the key 71 in the notches in said gears.

The operation of the described construction is as follows: The speed-gear driving-shaft 60 is constantly rotated from the spindle through the described train of gears, and consequently the back gears 81 and 82 will receive constant rotation. If the key is brought into engagement with a notch of any one of the three gears to the left upon the shaft 50, then the rotary motion will be transmitted from the driving-shaft 60 directly to the driving-shaft 50 through that one of the gears which is for the time being keyed thereto and that one of the three gears 62, 63, and 64 which is in engagement with it. If the key is then slid along until it engages a notch of one of the three gears to the right upon the shaft 50, (shown in Fig. 23,) then rotary motion will be transmitted from the driving-shaft 60 through the compound gear 81 and 82 and the gear meshing with it to the sleeve 68, upon which the three gears 65, 66, and 67 are mounted, and thence to that one of the gears on the feed-screw shaft 50 with which the key is for the time being in engagement.

Within the gear-case 80 is another nest of gears of different diameters, loose upon the shaft 90, associated with the carriage-feed screw 21, to which it may be connected by means to be presently described. Loosely mounted upon the shaft 90 are the gears 92, 93, 94, 95, 96, and 97, meshing with the gears 62 to 67, inclusive, on the driving-shaft 60. Within the longitudinal groove 91 in this shaft 90 is a key-bar 70^a, substantially like the key-bar 70 in construction and mode of operation, and having a key 71^a for engaging in any one of a series of internal notches 99 provided in said gears upon the shaft 90. Any suitable means may be provided for sliding the key-bar 70^a in its groove; but I prefer to provide this key-bar with a rack-sleeve 74^a, substantially like the sleeve 74 and substantially the same in operation. In the same manner in which the gears upon the shaft 50 are connected with the gears upon the shaft 60 the gears upon the shaft 90 may be connected. Therefore said shafts 50 and 90 may be driven at many different rates of speed by the same shaft 60, whose speed is not varied at all. The motion of the shaft 90 is transmitted to the carriage feed-screw 21 in the construction, as shown, by means of a bevel-gear 22, attached to said shaft 90, which meshes with a bevel-gear 23, attached to the shaft 25, journaled to the frame of the machine. Another bevel-gear 24 at the opposite end of this short shaft engages with two bevel-gears 26 27, loosely mounted around the feed-screw in a part of the machine which prevents them from moving endwise thereon. Between these two bevel-gears on the feed-screw is a double jaw-clutch 28, which is splined to the feed-screw. It may occupy a position in engagement with a jaw-clutch on either of the two gears 26 27 or it may occupy a position out of engagement with either. If it engages with one of said gears, the feed-screw is driven in one direction. If it engages with the other, it is driven in the opposite direction. This clutch is operated by a handle 29, attached to a short shaft 29^a, having at its lower end the crank-pin 29^b, which engages in the circumferential groove 28^a in said clutch. The other shaft 50 is placed in axial alinement with the turret-slide feed-screw 31. It has one member 32 of the jaw-clutch secured to it, while the other member 33 of said jaw-clutch is splined to said turret-slide feed-screw 31. When these clutches are in engagement, the feed-screw will be rotated in one direction only and at a speed depending upon the speed of the shaft 50. The direction in which the feed-screw will rotate

when driven by the described mechanism is that in which the carriage will be fed when working on a cut. It is necessary, however, to provide means for moving this turret-slide in the contrary direction, and it is desirable that means be provided for moving the said slide rapidly toward the work. The power to so move the turret-slide is taken from an independently-driven shaft 100, mounted on the back side of the machine, through a transverse shaft 101, having at one end a bevel-gear 102, meshing with a bevel-gear 36 on the feed-screw 31. At its opposite end is a beveled friction-wheel 106, which may be caused to engage with either of two beveled friction-wheels 103 104, which are splined to shaft 100 and are mounted in a box 105, slidably connected with the frame of the machine. The main function of this shaft 100 is to turn the turret; but it is also utilized for the purpose above explained—to wit, to cause the quick movement of the turret-slide backward or forward. If the box 105, in which these two friction-wheels 103 104 are mounted, is moved in one direction, one of them will engage with the friction-wheel 106 on the shaft 101, and the result will be that the turret-slide feed-screw is rotated in one direction. If said box is moved so as to bring the other cone-wheel into engagement with the cone-wheel on the shaft 100, said feed-screw will be rotated in the contrary direction, and in either case it will rotate faster than when connected with the speed-gearing first explained. The box containing these friction-wheels is mounted on a horizontal guide between the gibs 107 on the rear side of the machine-frame, and it is moved by the oscillation of a rock-shaft 108, having at one end an operating-handle 110 and at the other end an arm or finger 109, which lies between two shoulders 113 on the lower side of the box. This handle carries a spring-pin 111, adapted to take into hole 112 in the machine-frame, whereby it is held in the desired position.

Attention is now directed to the turret-slide 30, the turret 120 thereon, and the mechanism associated with them. The turret-slide is moved along the ways on the machine-frame by the feed-screw 31, which engages with a nut 32^a, fast to said slide. The main body of the turret 120 has on its under side a circular groove which receives the circular V-shaped track 44 on the top of the slide, said track serving as the support and guide for the turret. Projecting down through the top of the slide is what may be called the "turret-stem" 121, which is cylindrical and is concentric with said circular groove and is an integral depending portion of said turret. On this stem is a projecting annular flange 123, the same being the outer edge of a plate 124, fastened to the lower end of the turret-stem by means of screws. The top surface of this flange is beveled from the stem outward and upward, and this beveled surface lies below the oppositely-beveled surface of the roof 45 of an annular recess 46 in said slide around said stem. The recess is therefore contracted gradually from the turret-stem outward, and in this recess is a sectional clamping-ring 130, composed of two sections. The proximate ends of these sections on one side of the turret are beveled, and between them lies an adjusting-wedge 131, which may be moved in or out by a bolt 132, and thereby increase or diminish the diameter of this clamping-ring. To the opposite ends of these ring-sections the two toggle-levers 137 138 are pivoted. By straightening the toggle the clamping-ring is expanded, and thereby the turret is clamped upon the track 44. Attached to the toggle-joint is a draw-bar 133, which is under the influence of a spring 135, tending to push it in the direction which straightens the toggle. The rear end of this draw-bar is connected with a lever 134, by which the bar may be drawn back against the force of this spring. The turret, as shown, has six operating-faces, and means are provided for centering the turret in either of the six operating positions. The means consist of a horizontal movable centering-pin 140, mounted in the turret-slide and adapted to enter either of six properly-placed sockets 126 in the turret-stem. The sockets and this centering-pin are correspondingly tapered, so that they bring the turret to the proper position, and it is subsequently clamped in this position by the clamping-ring. This pin is moved forward into a socket by a spring 141, but is withdrawn by the action of a lever 142, which is pivoted to the slide. One arm of this lever enters a notch between two shoulders 143 on the pin, which notch is so long that the lever may have some movement between the said shoulders before the pin 140 is moved. The same arm of the lever is pivotally connected with the draw-bar 133 and necessarily moves with it. For example, if the draw-bar be moved backward to move the lever and unclamp the turret, as specified, it will after the clamping-ring has been contracted enough to release said turret cause said lever 142 to engage with the rear shoulder 143 and withdraw the centering-pin. The automatic release of the turret from this clamping-ring and centering-pin is effected by the engagement of one arm of the lever 142 with the inclined surfaces 145, fixed to the frame of the machine. This engagement takes place when the slide 30 is moving backward. Means are provided for automatically turning the turret from one position to another when it is thus released from the clamping action of the ring and the holding power of the centering-pin. Projecting from the lower end of the turret are six pins 127. Projecting axially downward from the turret is a stud 128, to the lower end of which a bevel-gear 129 is made fast. Loosely mounted upon this stud is a rocking arm 150, which is connected, by means of a pitman 151, to a crank-pin 152 on a rotating worm-wheel 153, which

wheel is rotatably mounted on the under side of the turret-slide. This worm-wheel is driven by a worm 154, splined to a shaft 155, rotatably mounted in the machine-frame beneath the turret-slide. This shaft 155 is driven constantly by a train of gears 156 from the shaft 100 at the back side of the machine. It is obvious that the rocking arm 150 is in constant motion. On this arm is a pivoted dog 157, which is approximately triangular in form, the pivot being near one of the angles. The dog therefore has two arms, one of which, being farther from the center than the pivot of the dog, is adapted to engage the pins 127 when occupying the normal position in which it is held by a spring 158. Another arm or tail of this dog is held by this same spring in engagement with the periphery of one or the other of two cams 160 161, which are rotatably mounted upon the hub of rocking arm 150. These cams are ordinary circular disks having cam projections so located as to perform the functions hereinafter ascribed to them. One of these cams is called the "automatic" and the other the "non-automatic" cam. The automatic cam 160 has an arm 162, which is connected by a rod 163 with the draw-bar 133. When the draw-bar has been moved inward, so as to cause the locking-ring to clamp the turret, this cam is moved in such a position that the tail of the dog 157 will engage with the large part of the cam 160, and thus hold the dog in a position where it cannot engage said pins. When, however, the draw-bar is drawn backward, this cam is turned, and thereby its large part is drawn away from the tail of the dog, which is then moved by its spring into position to engage with one of these pins and turn the turret. If it is desired to turn the turret by hand, the clamping-ring is loosened and the centering-pin withdrawn by the lever 134, before referred to. Before doing this the non-automatic cam 161 is turned so that the enlargement thereof will engage with the dog 157 and hold it in a position where it cannot engage with the turret-pins. This non-automatic cam is moved by a rod 164, connected with an arm 165 on the cam, which passes out through the turret-slide to a convenient position for operating it. A spring locking-pin 166 is mounted in the turret-slide, engages in one or the other of two recesses 167 in this bar, and thereby holds the non-automatic cam in either of the two positions described.

The machine contains an automatic stop device for the turret-slide, which we will now describe.

A longitudinally-ribbed stop-shaft 170 is rotatably mounted on the frame of the machine below the turret-slide. A tubular pinion 180 embraces this shaft and has grooves 181, into which the ribs 171 on the shaft project, whereby this pinion and stop-shaft must rotate in unison. This pinion is, however, mounted on the slide and moves with it. This pinion 180 engages with a gear 182 on a shaft 183, which is mounted on the slide and has at one end a bevel-gear 184, meshing with the bevel-gear 129, fast to the turret. Tappets 172 are adjustably attached to this stop-shaft in the six grooves 173, (see Fig. 12,) provided for this purpose. These grooves are undercut or dovetailed, and the tappets are dovetailed to fit said grooves, and the tappets are held in place within said grooves by means of bolts screwing through the tappets against the bottoms of said grooves. These tappets are beveled on their operating-faces 175, and they are adapted to be engaged by a downwardly-extending pin 190, attached to the slide and having a beveled operating-face 191. Now as the slide moves forward in the working direction it will come to a position where the beveled face of this pin will engage the beveled face 175 of whichever tappet 172 on the stop-shaft has been moved into its path. The engagement of these two beveled faces will cause the stop-shaft to turn a little. The stop-shaft carries on one end a series of cam-faces 176, which engage with corresponding cam-faces 201 on the upper end of a lever 200, which is pivoted to the frame of the machine. When this stop-shaft is turned as much as it will be by the engagement of the beveled faces of said pin and tappet, the cam-faces on the stop-shaft and lever by their coöperation rock the said lever, the result being, as will be presently explained, the unclutching of the feed-screw 31 from the source of power. Now it is clear that this slight turning of the stop-shaft cannot be accompanied by any movement of the turret, with which it is connected, as described, because the turret is clamped where such movement takes place. The slight independent movement of the stop-shaft is, however, permitted by reason of the connection between the shaft 183 and the gear 182. In the hub of the gear is a notch 185, and secured to the shaft is a pin 186, entering this notch. When the shaft 183 is turned by the turret, the pin 186 comes against one end of this notch, and consequently the gear must turn and with it the stop-shaft; but when the stop-shaft is turned forward by the pin 190 and tappets 172 this gear 182 turns forward slightly on its shaft. The spring 187 connects the shaft and gear 182, and its action is to hold in contact the pin and the operating-shoulder in the notch in the gear, except when moved apart, as stated. The lower end of the lever 200 projects out through the front part of the frame of the machine into contact with the long clutch-operating rod 205, which rod is moved endwise by said lever, with the result of uncoupling the turret-slide feed-screw 31 from the constantly-driven shaft 50, with which it is connected by the clutch 32 33, before referred to. The feed movement of the turret-slide is thereby stopped or nearly stopped. It is completely stopped when certain flat surfaces 179 192 on the tappet 172 and the pin 190, re-

spectively, come into contact with each other, as they will almost immediately their beveled surfaces have produced the results just referred to. This clutch-operating rod 205 passes loosely through an arm 211 of a latch 210, which is pivoted to the frame of the machine. Surrounding the rod 205 and lying between the latch-arm 211 and the end of a lever 206 is a spring 209. This lever 206 is the clutch-operating lever and is pivoted to the frame of the machine. On it is a pin 208, which is adapted to be engaged by the latch 210, which prevents the unclutching movement of said lever. Now when the rod 205 is moved endwise by the lever 200 a shoulder 212 on said rod engages the arm 211 of the latch, which is thereby moved on its pivot and out of its engagement with the pin 208. Thereupon the spring 209, which has been compressed, operates the lever 206, whereby the shaft 90 and feed-screw 31 are uncoupled.

Attention is called to the form of the turret as shown clearly in Fig. 8. Its alternate faces are at different distances from the center and are of different sizes. The wide faces are nearer the axis and are especially suited for the attachment of box-tools, whereby said tools will be as near as practical to the axis of the turret. The intermediate narrow faces are farther removed from the axis, thereby leaving ample stock in which to form the sockets to receive the boring-tools.

We claim—

1. In a lathe, the combination of a driven speed-gear shaft, a plurality of gears of various diameters concentric with said shaft and driven thereby, with two nests of gears engaging with said gears, two longitudinally-grooved shafts upon which said nests of gears are respectively mounted loosely, longitudinally-movable keys in the grooves in said shafts, and mechanism for independently moving said keys whereby either of said driven shafts may be connected with either of the gears loosely mounted upon it, the carriage feed-screw, and the turret-slide feed-screw, and mechanism respectively connecting and disconnecting said feed-screws with the two driven shafts.

2. In a lathe, the combination of a driven speed-gear shaft, a turret-slide feed-screw, mechanism, including a clutch, for connecting said shaft and feed-screw, an independently-driven shaft, two beveled wheels splined to said shaft, and mechanism for transmitting motion through either of said bevel-wheels to the feed-screw.

3. In a lathe, the combination of a driven speed-gear shaft, a turret-slide feed-screw, mechanism, including a clutch, for connecting said shaft and feed-screw, an independently-driven shaft, two beveled friction-wheels splined to said shaft, a box slidably supported upon the frame of the machine and in which the hubs of both friction-wheels are rotatably mounted, a transverse shaft having secured to it a bevel friction-wheel journaled in the frame to engage with the friction-wheels on said independently-driven shaft, and operative connections between said transverse shaft and the feed-screw.

4. In a lathe, the combination of a change-speed driven shaft, an independently-driven shaft, a turret-slide, and the feed-screw therefor, with mechanisms for connecting said feed-screw shaft with the driven speed-gear shaft or with the independently-driven shaft, and mechanism whereby when the latter connection is made the feed-screw shaft may be turned in either direction.

5. In a lathe a turret-slide, feeding mechanism therefor, mechanism including a clutch for connecting said feeding mechanism with the spindle, combined with a turret rotatably mounted on the slide, an independently-rotating shaft, mechanism operated by said shaft for turning said turret, and mechanism for connecting the turret-slide feeding mechanism with said independently-operated shaft, substantially as specified.

6. In a lathe, a turret-slide having an opening through its top and on its top around said opening a V-shaped circular track, a turret rotatably mounted on said track and having a stem extending down through the opening in the slide, mechanism for turning the turret, and centering and clamping devices operating upon the turret-stem, substantially as specified.

7. In a lathe, the combination of a turret-slide, and a turret rotatably mounted thereon, with a sectional clamping-ring lying in an annular recess around said turret, a wedge for determining the relationship of adjacent ends of said sections, and means engaging with the other adjacent ends of said sections for moving them toward and from each other.

8. The combination of a turret-slide, a turret rotatably mounted thereon and having a plurality of recesses for a centering-pin, a clamping-ring for fastening the turret to said slide, mechanism, including a sliding draft-bar, for expanding and contracting said ring, a movable centering-pin having an operating-shoulder, a lever pivoted to the slide and connected with said draft-bar and having its end extended to a position where it will engage with said shoulder, and cam-surfaces in the frame of the machine with which one arm of said lever engages as the slide is fed backward, whereby the clamping-ring is first loosened and then the centering-pin is withdrawn, substantially as specified.

9. The combination of a turret-slide, a turret rotatably mounted thereon and having a plurality of recesses for a centering-pin, a clamping-ring for fastening the turret to said slide, mechanism including a sliding draft-bar for expanding and contracting said ring, a movable centering-pin having an operating-shoulder, a lever pivoted to the slide and connected with said draft-bar and having its end extended and adapted to engage with said

shoulder, and springs for moving said centering-pin and draft-bar in the operating direction, and mechanism connected with said draft-bar for moving it in the opposite direction.

10. A turret-slide, a turret rotatably mounted thereon having a plurality of pins projecting down from its lower side, a stud disposed axially with respect to said turret, an oscillating arm mounted on said stud, a dog on said arm and adapted to engage with said pins, a crank mounted on the turret-slide, a pitman connecting said crank with said oscillating arm, and mechanism for turning said crank.

11. A turret-slide, a turret rotatably mounted thereon having a plurality of pins projecting down from its lower side, a stud secured axially to said turret and projecting downward therefrom, an oscillating arm mounted on said stud, a dog on said arm and adapted to engage with said pins, a crank mounted on the turret-slide, a pitman connecting said crank with said oscillating arm, a constantly-driven shaft mounted on the frame of the machine, a worm splined to said shaft and movable with said slide, a worm-wheel operating said crank and in engagement with said worm, and means for controlling the position of the dog upon said operating-arm whereby it may not engage with said pins.

12. The combination of a turret-slide, a turret rotatable thereon, a stud disposed axially with respect to said turret, a plurality of pins projecting downward from said turret, an oscillating arm mounted upon said stud, means for oscillating the same, a dog pivoted to said arm and adapted under certain conditions to engage with said pins to turn the turret, with a cam mounted axially with respect to the turret and adapted to engage with said dog and thereby to prevent its engagement with said pins.

13. The combination of a turret-slide, a turret rotatable thereon, a stud secured to and projecting from the lower side of said turret, a plurality of pins projecting downward from said turret, an oscillating arm mounted upon said stud, means for oscillating the same, a dog pivoted to said arm and adapted under certain conditions to engage with said pins to turn the turret, with a cam mounted axially with respect to the turret and adapted by its engagement with said dog to prevent its engagement with said pins, a clamping-ring and mechanism, including a draft-bar, for operating the same, a centering-pin, and mechanism connecting said draft-bar, centering-pin and cam whereby to cause their associated movement substantially as specified.

14. The combination of a turret-slide, a turret rotatable thereon, a stud secured to and projecting from the lower side of said turret, a plurality of pins projecting downward from said turret, an oscillating arm mounted upon said stud, means for oscillating the same, a dog pivoted to said arm and adapted under certain conditions to engage with said pins to turn the turret, with an automatic cam and a non-automatic cam, each mounted axially with respect to the turret and adapted to engage with said dog and to be moved into either of two positions wherein, by its engagement with said dog, it will permit or prevent the engagement of said dog with said pins, automatic mechanism for turning the automatic cam as the turret-slide is moving backward and forward, and mechanism for manually operating said non-automatic cam, substantially as specified.

15. In a lathe, the combination of a turret-slide, its feeding mechanism, a turret rotatably mounted upon said slide, and mechanism for turning turret from one position to another, with a rotatable stop-shaft mounted on the machine-frame, a plurality of adjustable tappets secured to said shaft and having beveled operating-faces, mechanism, intermediate of said turret and stop-shaft, which transmits motion from the turret to the stop-shaft but which permits the shaft to turn forward a short distance independently of the turret, a beveled stop secured to the slide and adapted to engage with said tappets, and mechanism operated by said independent movement of the stop-shaft whereby the slide feeding mechanism is disconnected from the source of power, substantially as and for the purpose specified.

16. In a lathe, the combination of a turret-slide, its feeding mechanism, a turret rotatably mounted upon said slide, and mechanism for turning turret from one position to another, with a rotatable stop-shaft mounted on the machine-frame, a plurality of adjustable tappets secured to said shaft and having beveled operating-faces and plane stop-faces, mechanism, intermediate of said turret and stop-shaft, which transmits motion from the turret to the stop-shaft, but which permits the shaft to turn forward a short distance independently of the turret, a stop secured to the slide and having a beveled face and a plane face adapted to engage with the corresponding faces on said tappets, and mechanism operated by said independent movement of the stop-shaft whereby the slide feeding mechanism is disconnected from the source of power, substantially as and for the purpose specified.

17. In a lathe, the combination of a turret-slide, its feeding mechanism, a turret rotatably mounted upon said slide, and mechanism for turning turret from one position to another, with a rotatable stop-shaft mounted on the machine-frame, a plurality of adjustable tappets secured to said shaft and having beveled operating-faces, mechanism, intermediate of said turret and stop-shaft, which transmits motion from the turret to the stop-shaft but which permits the shaft to turn forward a short distance independently of the turret, a beveled stop secured to the slide and adapt-

ed to engage with said tappets, cams secured to said stop-shaft, a lever operated by said cams, and mechanism operated by said lever for disconnecting said slide feeding mechanism from the source of power, substantially as and for the purpose specified.

18. In a lathe, the combination of a turret-slide, its feeding mechanism, a turret rotatably mounted upon said slide, a beveled gear secured to the turret, and mechanism for turning turret from one position to another, with a rotatable stop-shaft mounted on the machine-frame, a pinion journaled in the slide but splined to said stop-shaft, a plurality of adjustable tappets secured to said shaft and having beveled operating-faces, an intermediate shaft mounted on the slide and carrying a beveled gear in mesh with the gear on the turret, and another gear in mesh with said pinion, one of the gears on said intermediate shaft being connected with it by a slot and pin which permits a slight relative rotary movement, a beveled stop secured to the slide and adapted to engage with said tappets and thereby turn the stop-shaft a short distance, and mechanism operated by said independent movements of the stop-shaft whereby the slide feeding mechanism is disconnected from the source of power, substantially as specified.

19. In a turret-lathe, the combination of the turret-slide, a rotatable turret mounted thereon, a feed-screw operatively connected with said turret-slide, an independently-driven shaft, turret-actuating mechanism operatively connected with said shaft, and mechanisms for operatively connecting said feed-screw either with the lathe-spindle or with said independent shaft.

20. In a turret-lathe, the combination of the turret-slide, a turret rotatably mounted thereon, a feed-screw for operating said slide, mechanism, including a clutch, for connecting said feed-screw with the lathe-spindle, an independently-driven shaft, turret-turning mechanism operatively connected with said shaft, and mechanism including a reversing-gear adapted to connect said independent shaft with said feed-screw.

21. In a turret-slide, the combination of a rotatable turret having its alternate operating-faces located different distances from the axis of rotation.

22. The combination of a turret-slide, a rotatable turret mounted upon the slide said turret having one half of its operating-faces long and comparatively close to the axis, and the other half, intermediate of said long faces, short and comparatively far from the axis of rotation.

In testimony whereof we hereunto affix our signatures in the presence of two witnesses.

CHARLES E. SEARCH.
EDW. CHESHIRE.

Witnesses:
LUCIAN R. WORDEN,
FRANK H. JOHNSTON.