No. 635,887. Patented Oct. 31, 1899.

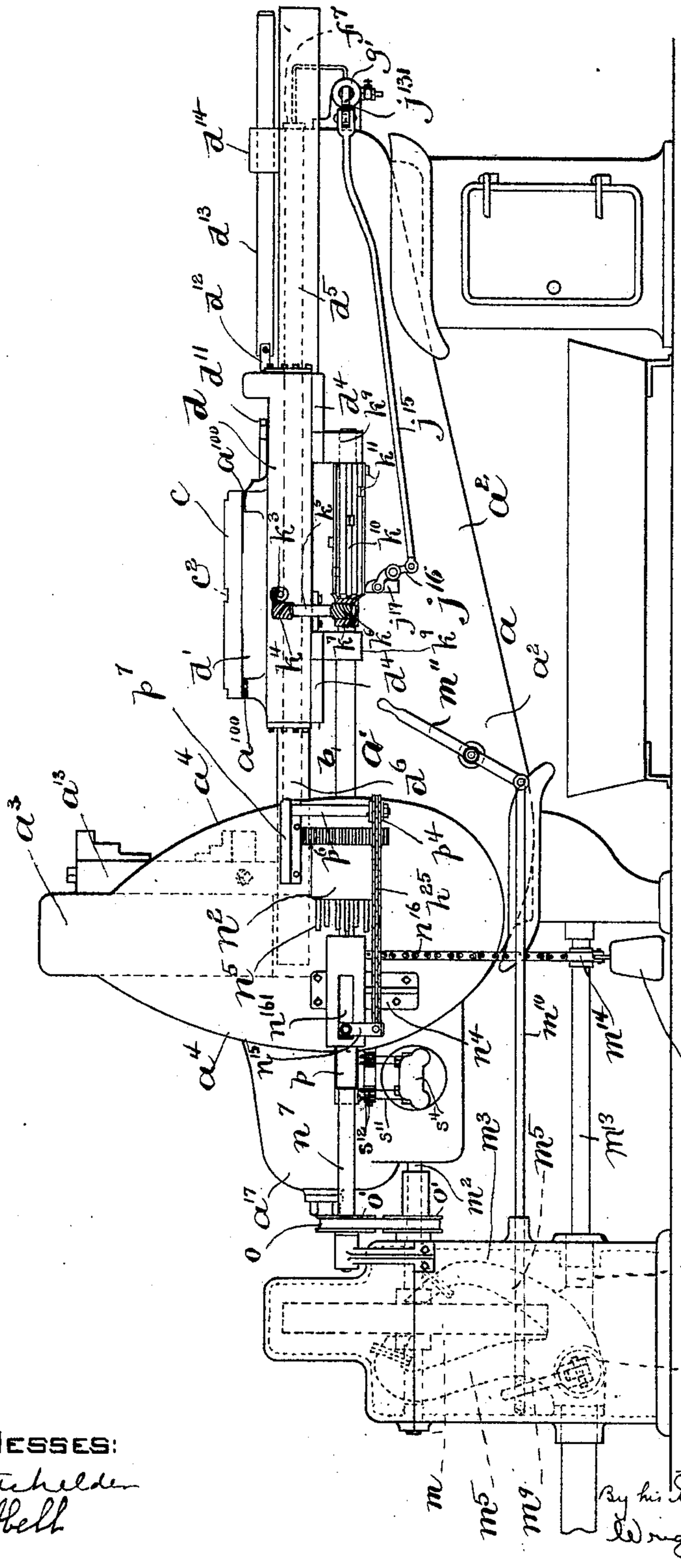
J. HARTNESS.

TURRET LATHE.

(Application filed Aug. 31, 1898.)

(No Model.) 20 Sheets—Sheet 1.

FIG. 1.



WITNESSES:
E. Batchelder
H. P. Abell

INVENTOR:
James Hartness
By his Attorneys
Wright Brown & Quinby

No. 635,887. Patented Oct. 31, 1899.

J. HARTNESS.

TURRET LATHE.

(Application filed Aug. 31, 1898.)

(No Model.) 20 Sheets—Sheet 2.

FIG. 2.

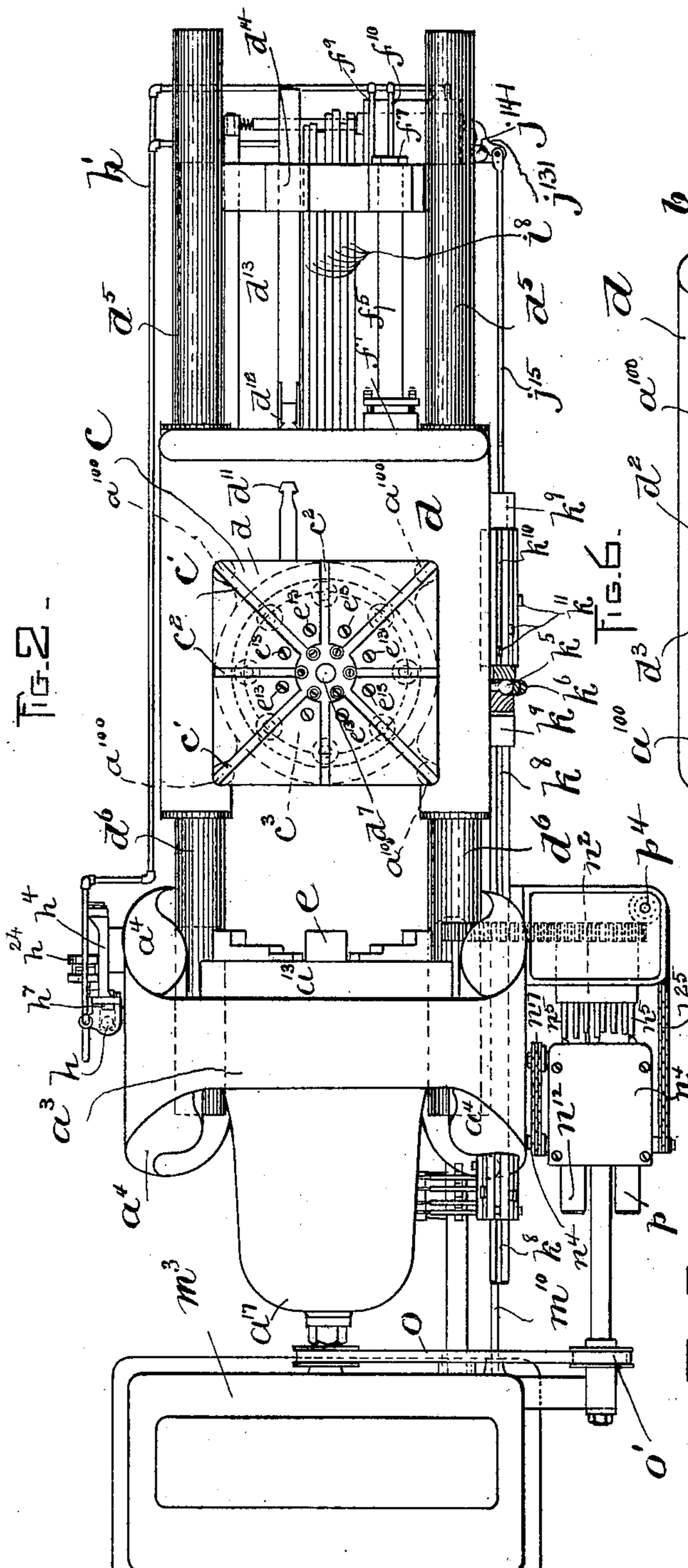


FIG. 6.

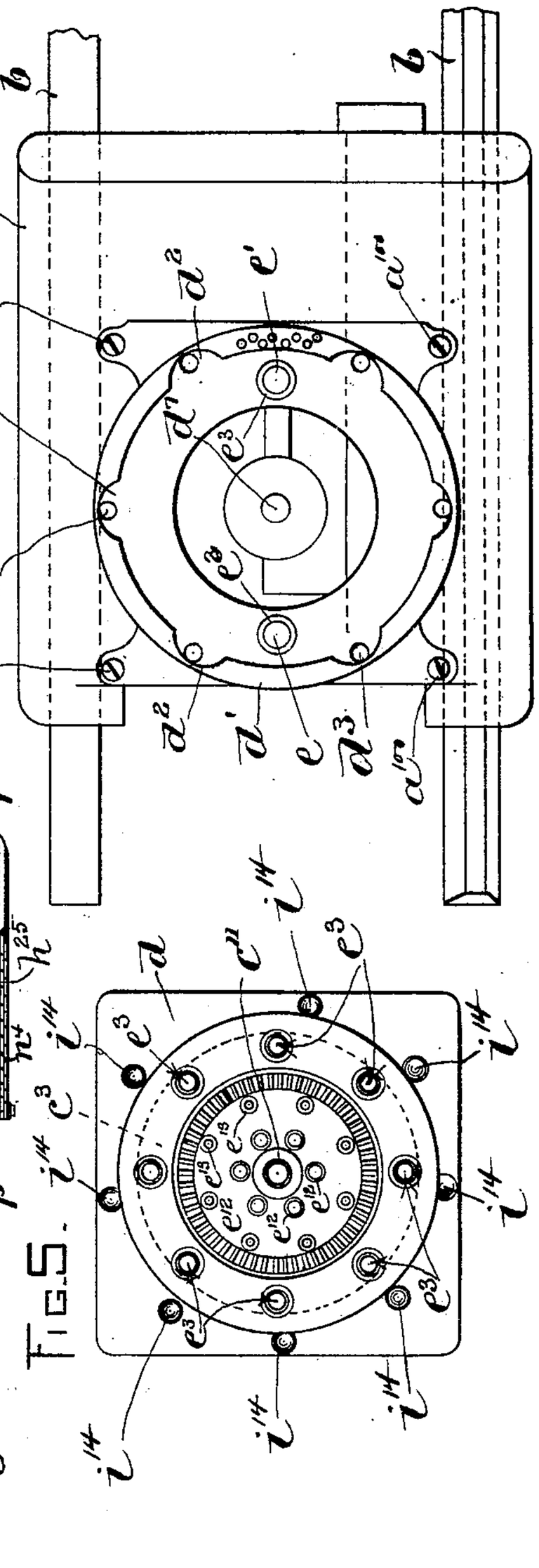


FIG. 5.

WITNESSES:
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INVENTOR:
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No. 635,887. Patented Oct. 31, 1899.

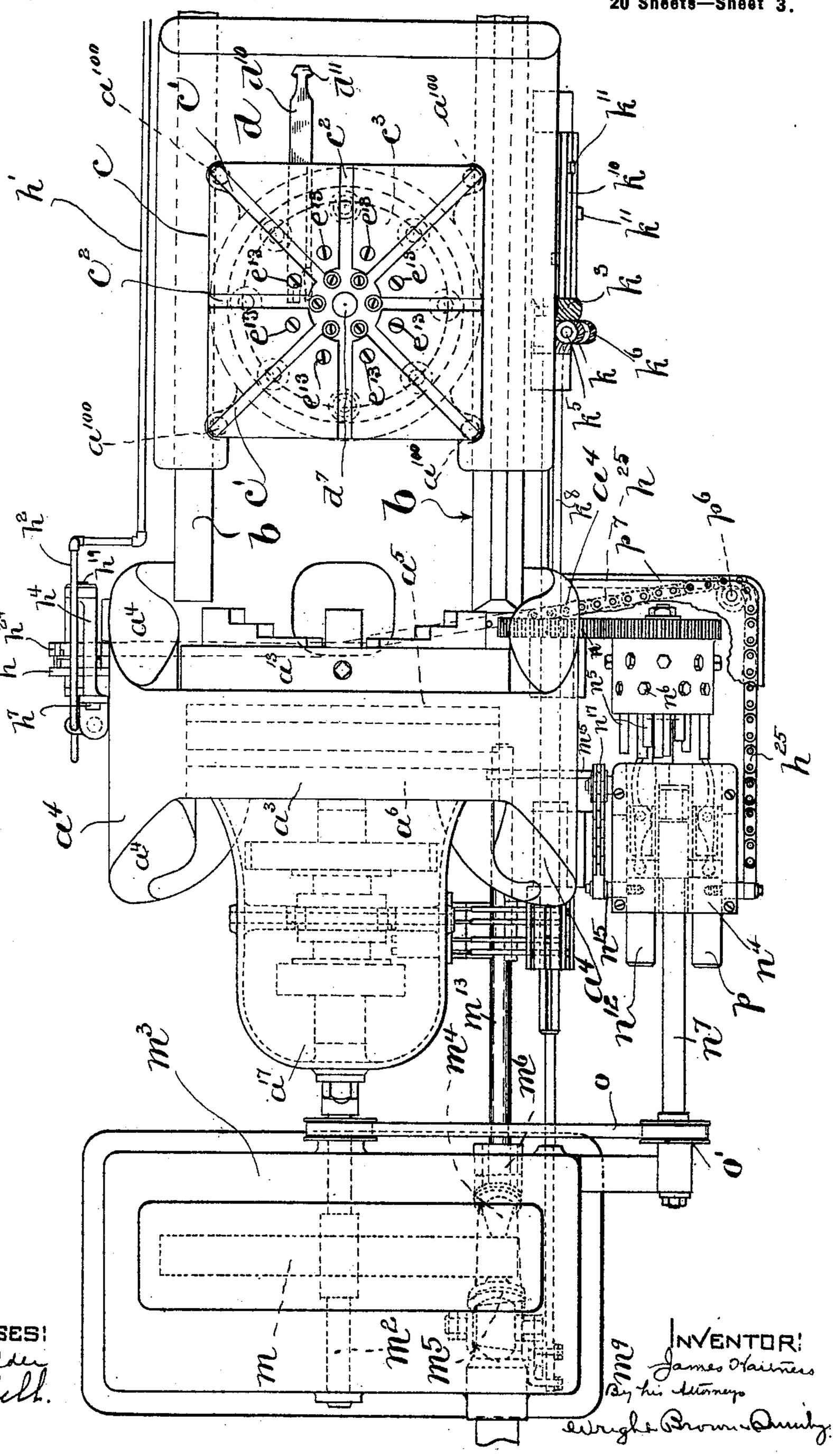
J. HARTNESS.

TURRET LATHE.

(Application filed Aug. 31, 1898.)

(No Model.) 20 Sheets—Sheet 3.

FIG. 2.



WITNESSES:
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H. P. Hubbard.

INVENTOR:
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No. 635,887. Patented Oct. 31, 1899.

J. HARTNESS.

TURRET LATHE.

(Application filed Aug. 31, 1898.)

(No Model.)

20 Sheets—Sheet 4.

FIG. 4.

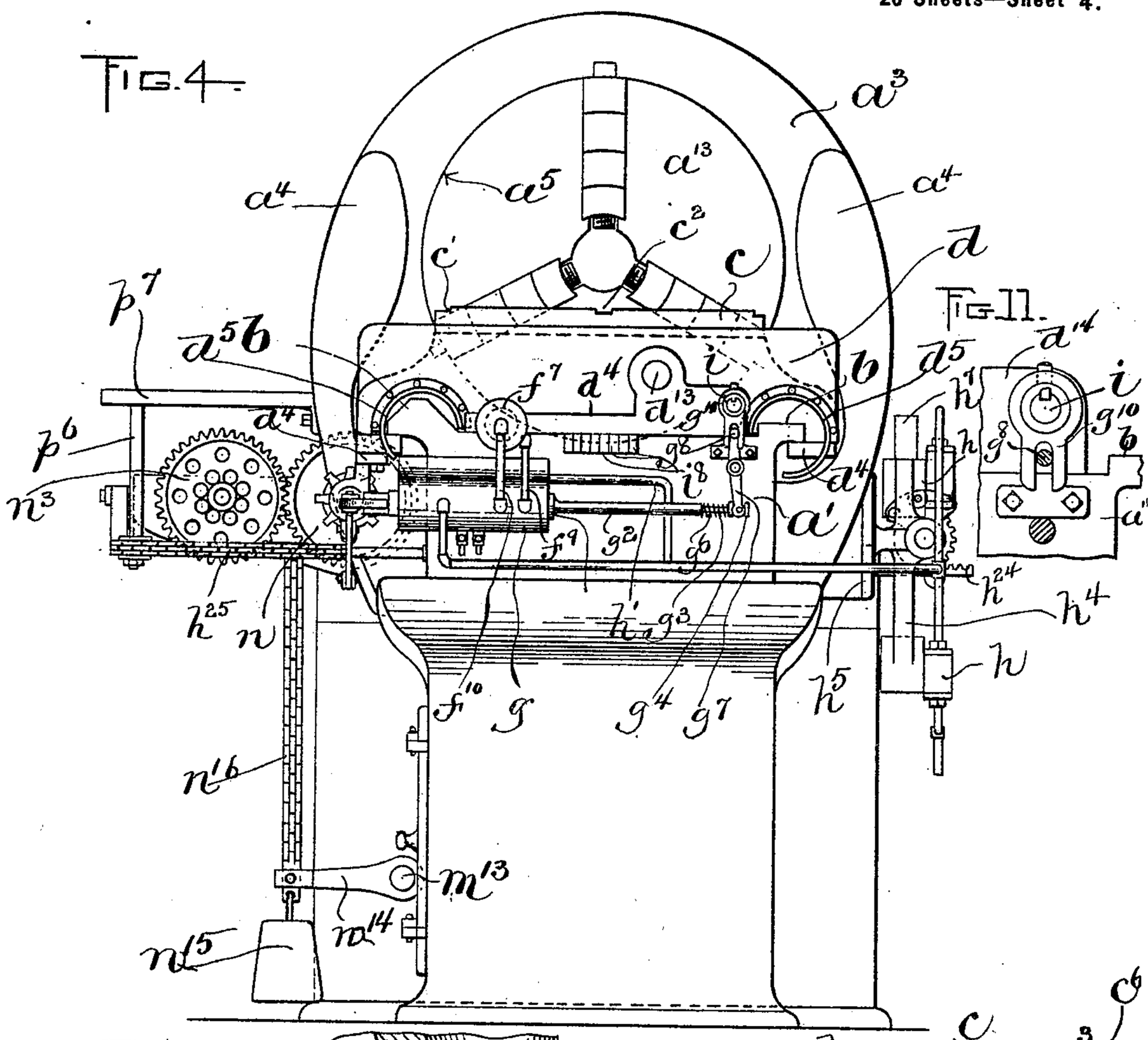


FIG. 11.

FIG. 7.

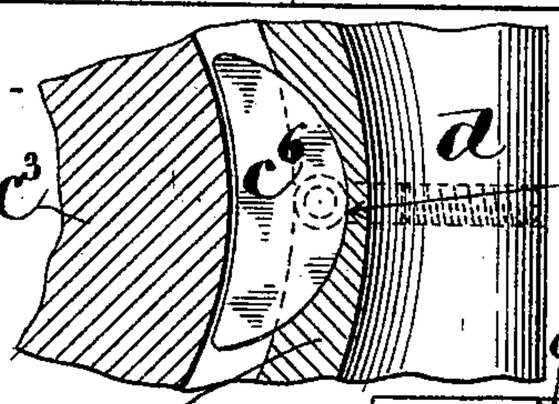


FIG. 9.

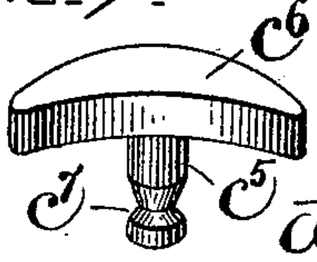


FIG. 8.

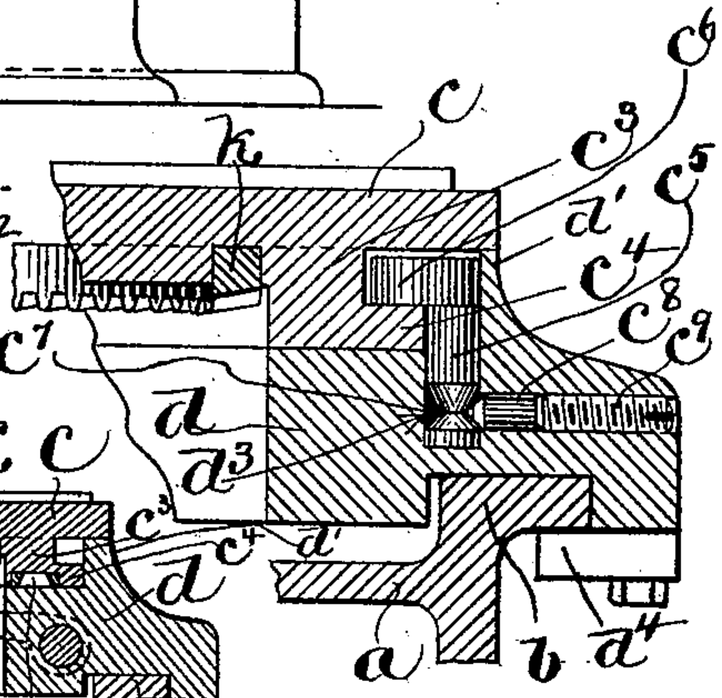
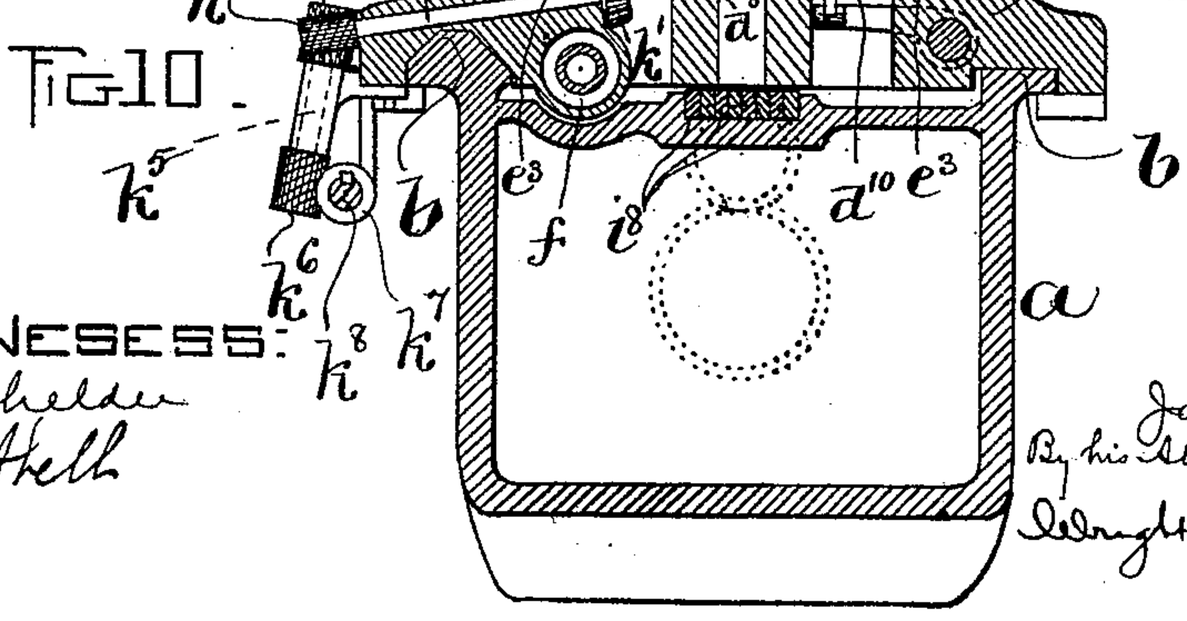


FIG. 10.



WITNESSES:
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H. P. Hall

INVENTOR:
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No. 635,887. Patented Oct. 31, 1899.

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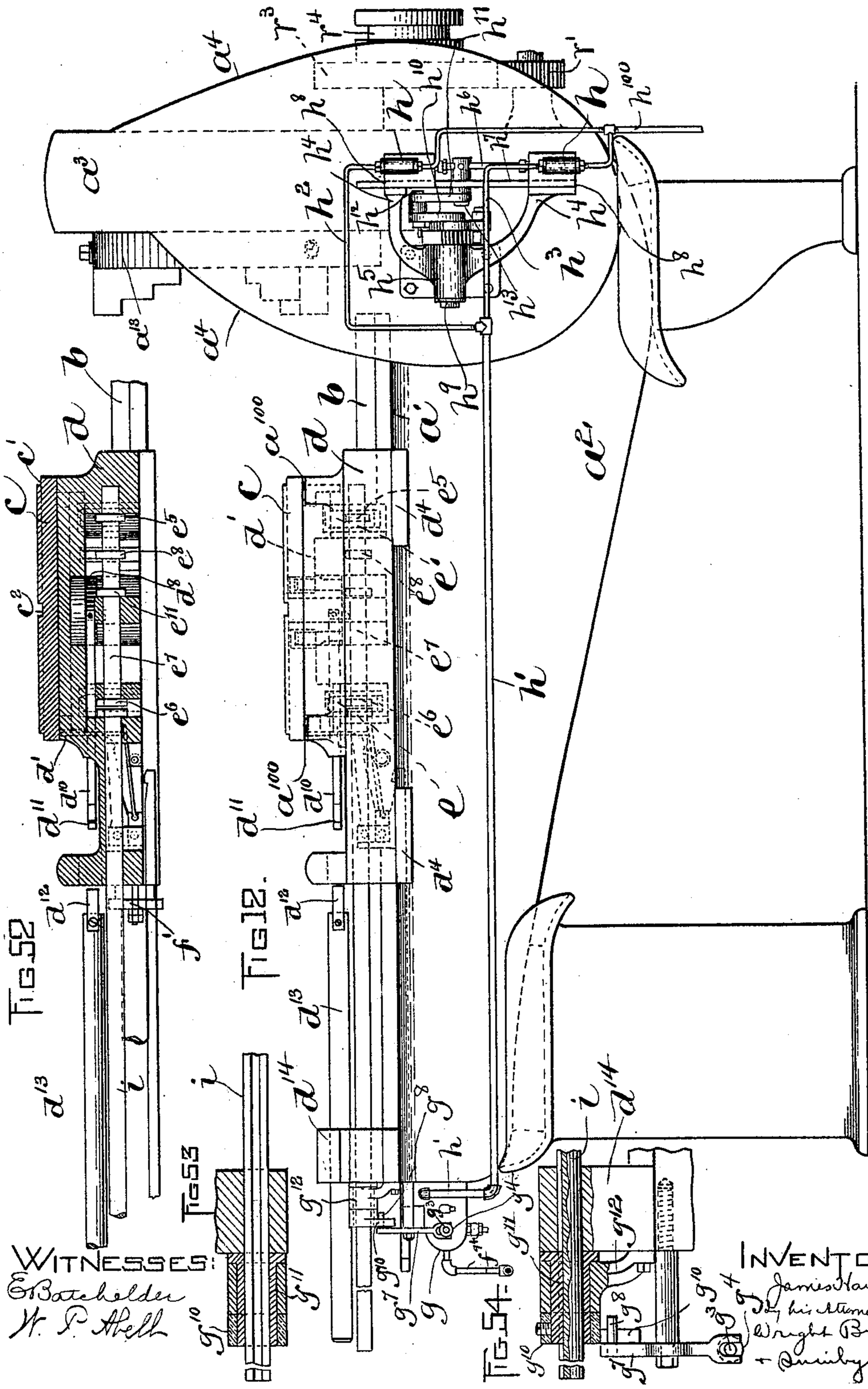
(Application filed Aug. 31, 1898.)

(No Model.) 20 Sheets—Sheet 5.



No. 635,887. Patented Oct. 31, 1899.

J. HARTNESS.

TURRET LATHE.

(Application filed Aug. 31, 1898.)

(No Model.) 20 Sheets—Sheet 6.

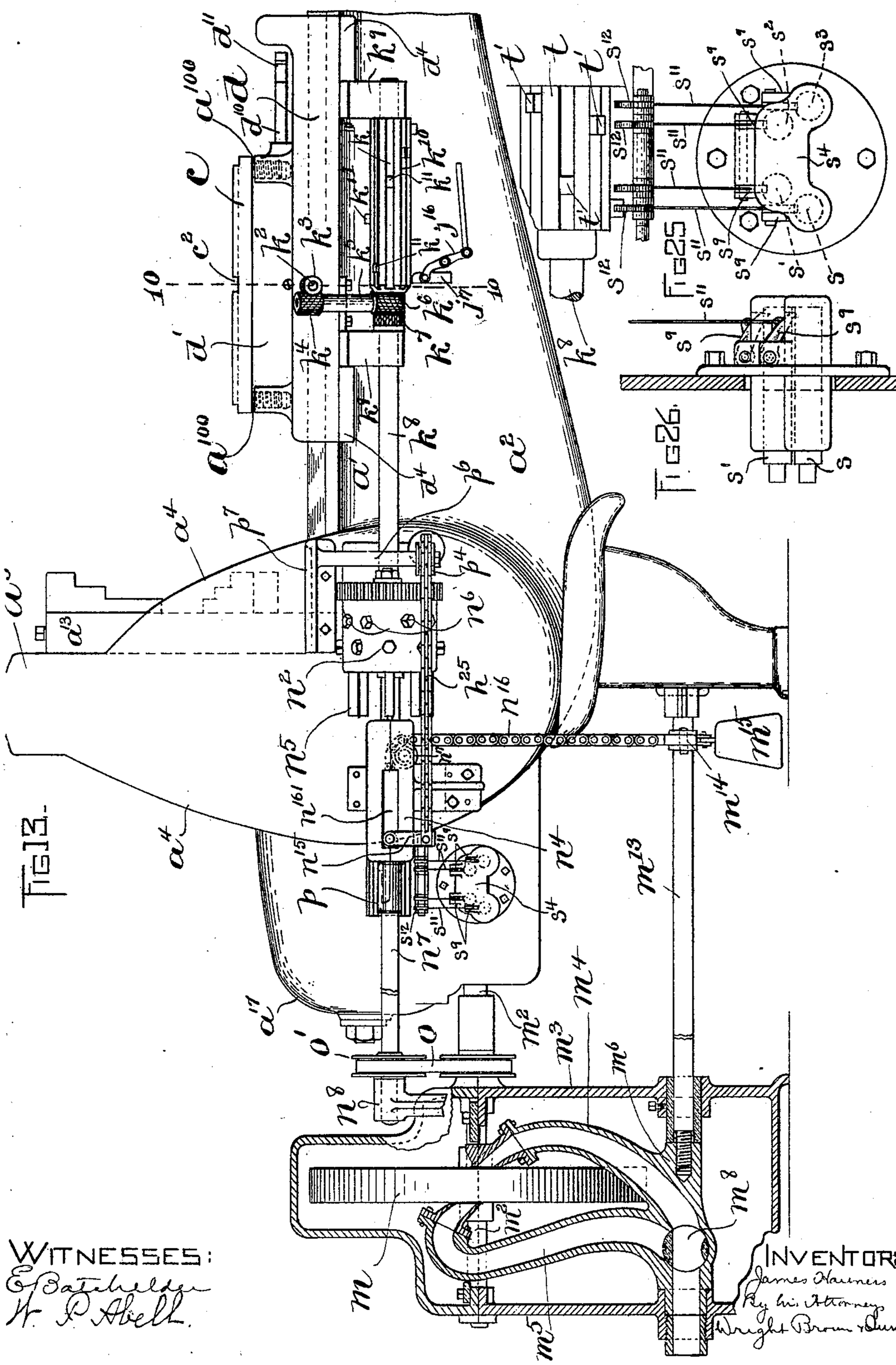


FIG 12.

FIG 26.

WITNESSES:
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No. 635,887. Patented Oct. 31, 1899.

J. HARTNESS.

TURRET LATHE.

(Application filed Aug. 31, 1898.)

(No Model.) 20 Sheets—Sheet 7.

Fig 14

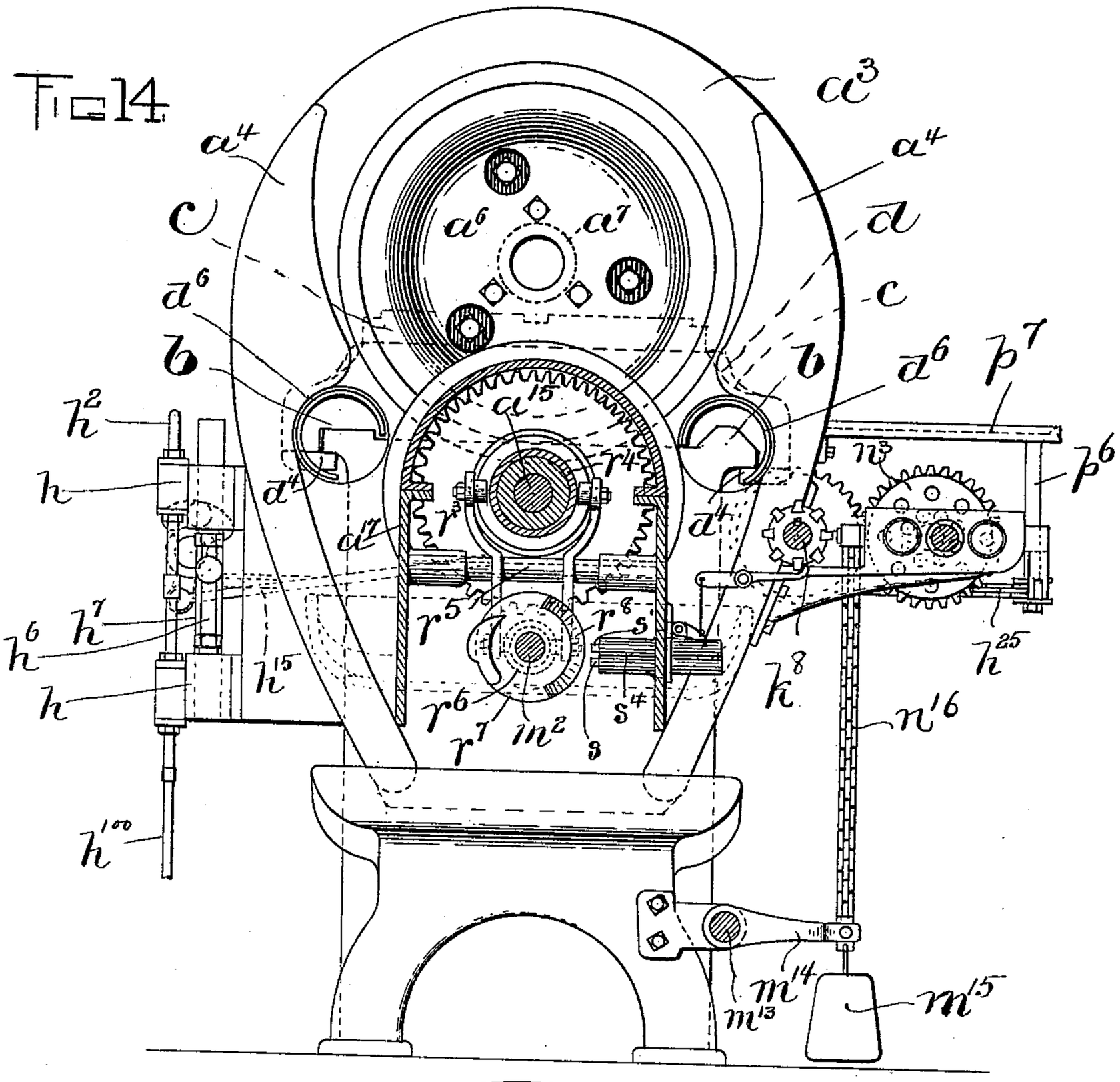
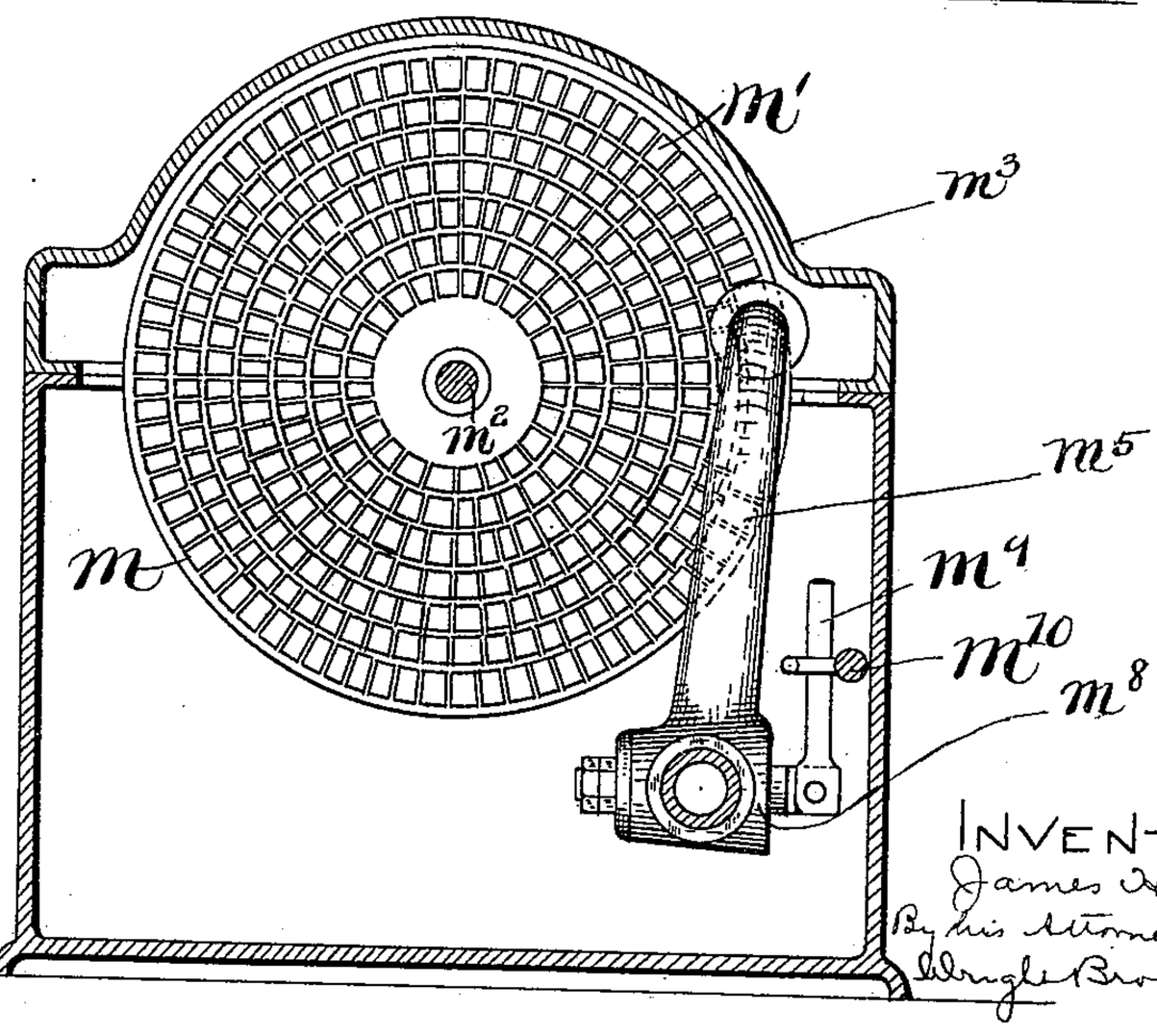


Fig 15



Witnesses
C. Batchelder
H. P. Abell

Inventor:
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No. 635,887. Patented Oct. 31, 1899.

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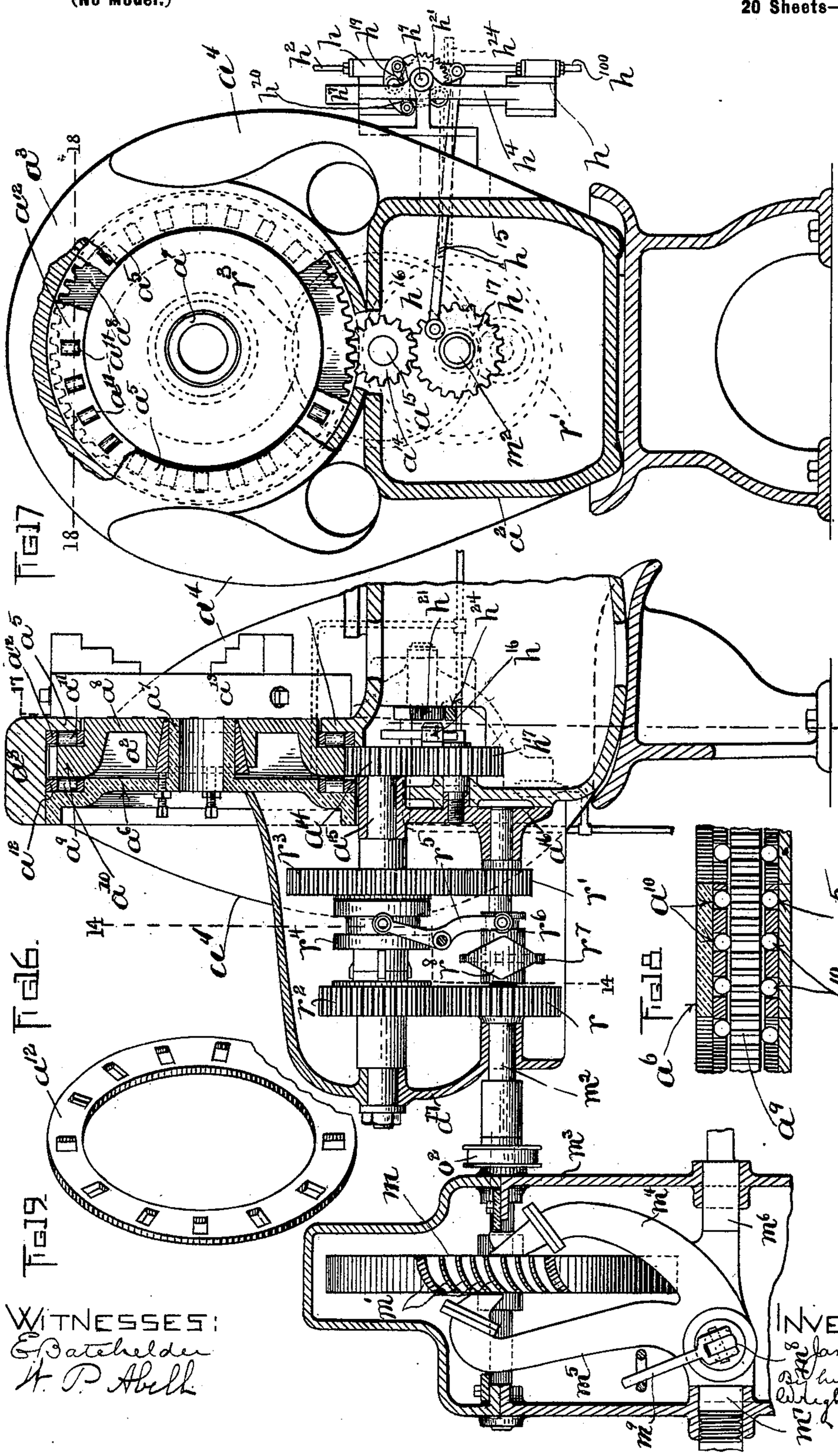
(Application filed Aug. 31, 1898.)

(No Model.) 20 Sheets—Sheet 8.



Witnesses:
E. Batchelder
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No. 635,887. Patented Oct. 31, 1899.

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(Application filed Aug. 31, 1898.)

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Fig. 30.

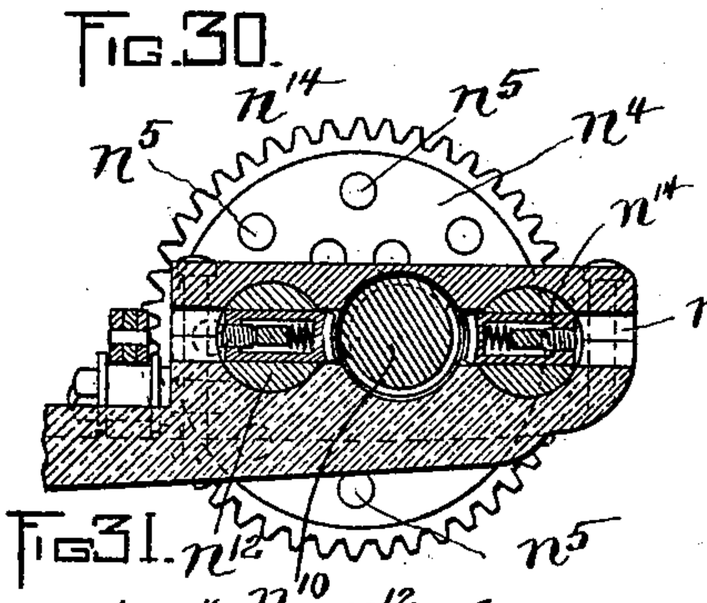


Fig. 31.

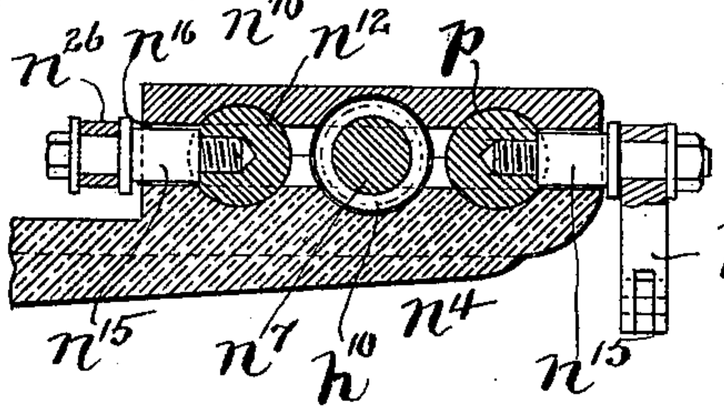


Fig. 20

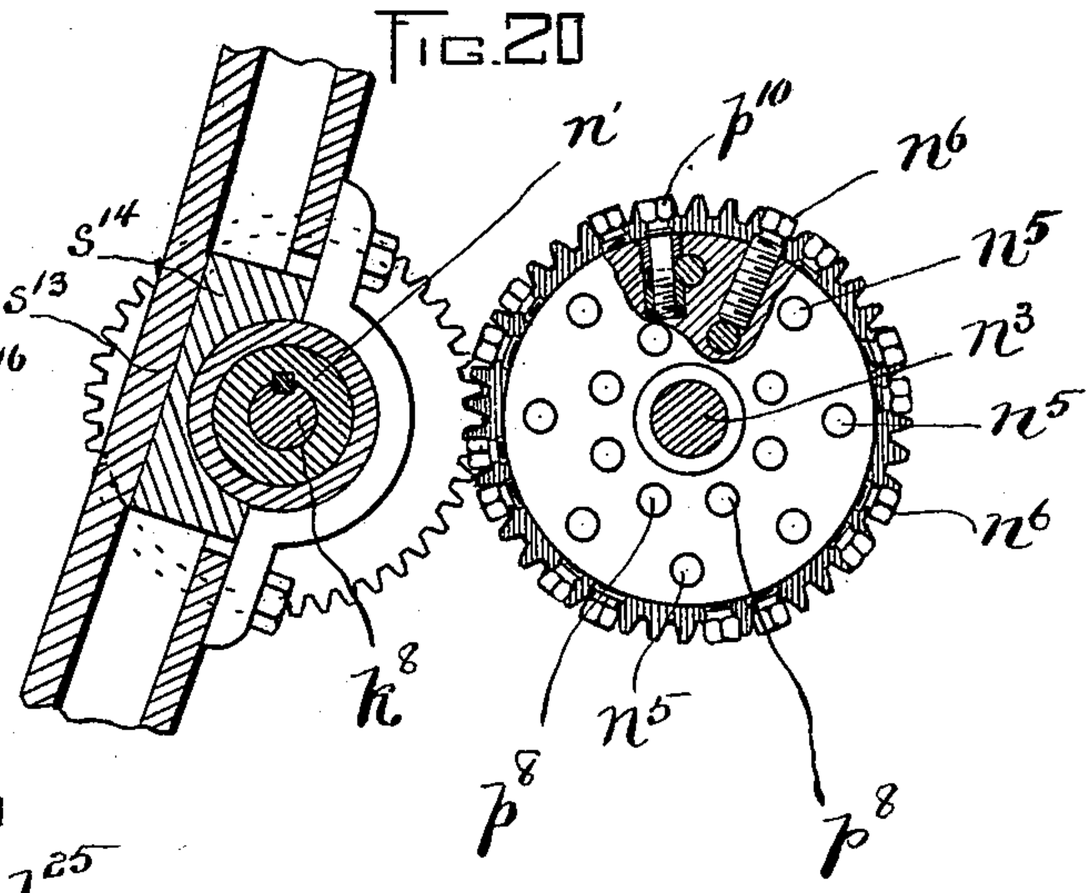


Fig. 21.

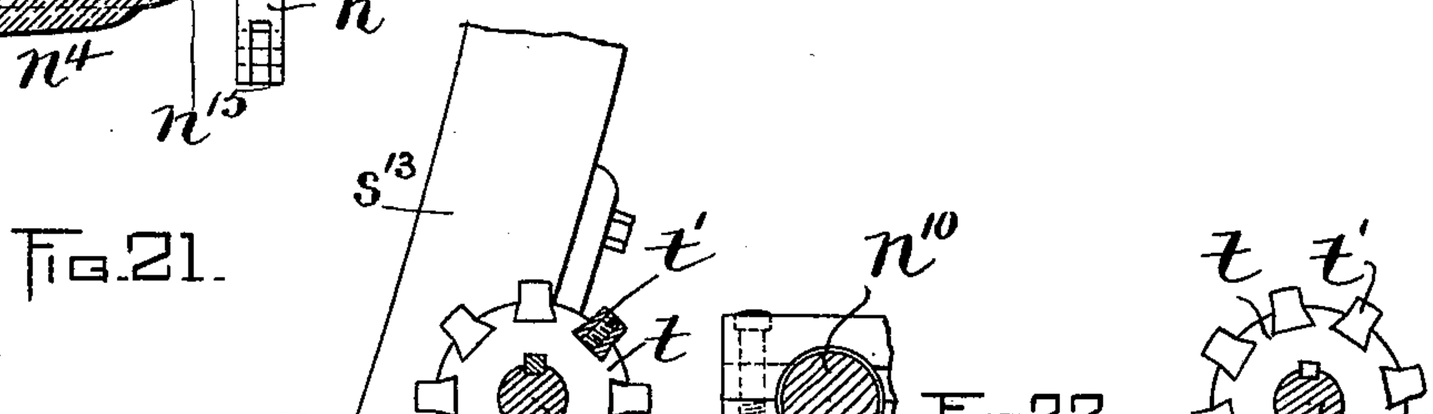


Fig. 22.

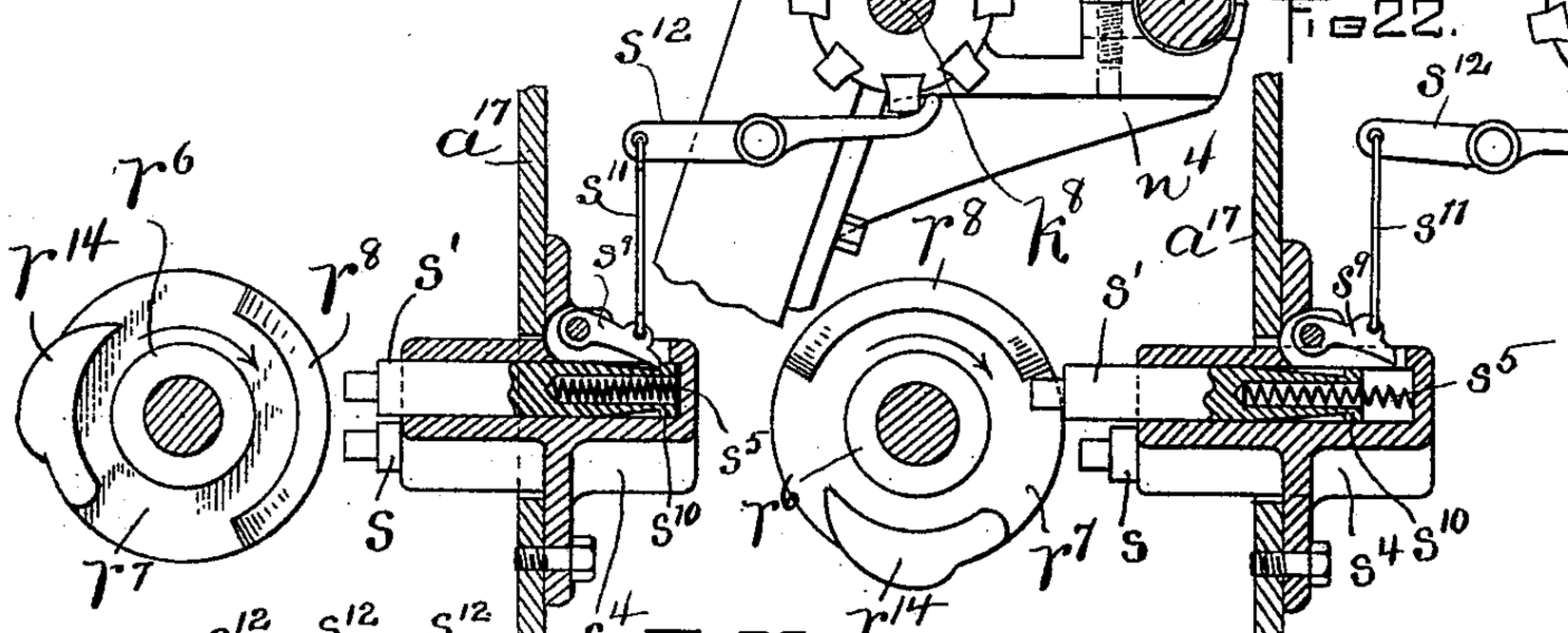
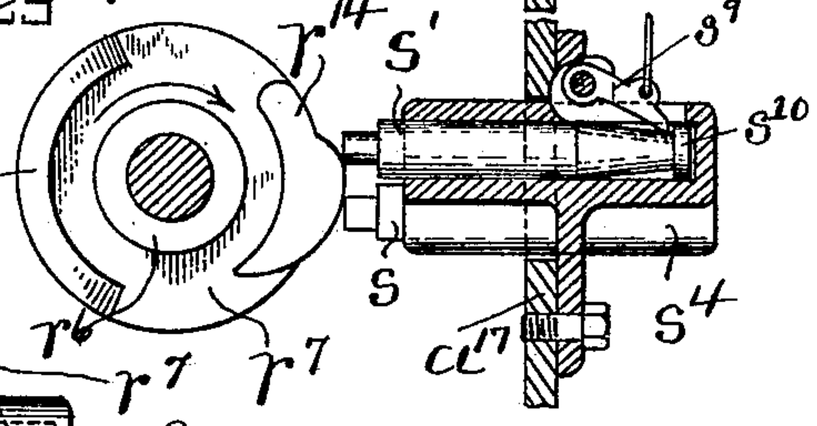


Fig. 23



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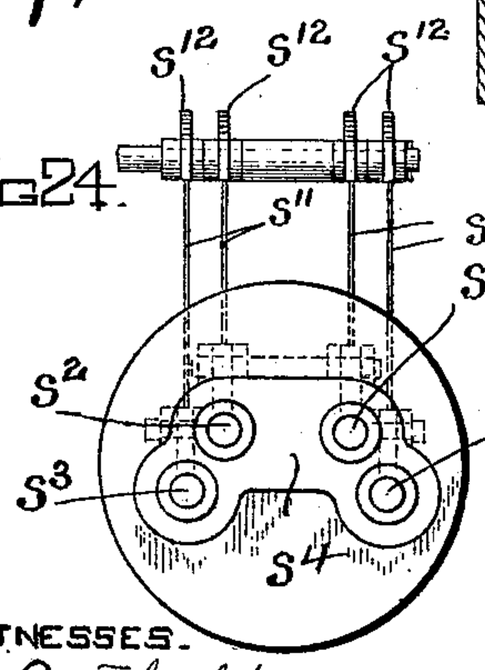
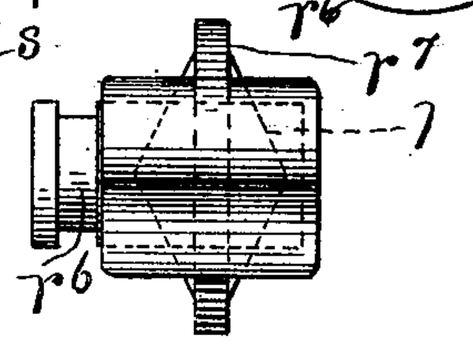


Fig. 27.



WITNESSES.
E. Batchelder
H. P. Abell

INVENTOR:
James Hartness
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No. 635,887. Patented Oct. 31, 1899.

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(Application filed Aug. 31, 1898.)

(No Model.) 20 Sheets—Sheet 10.

Fig 28

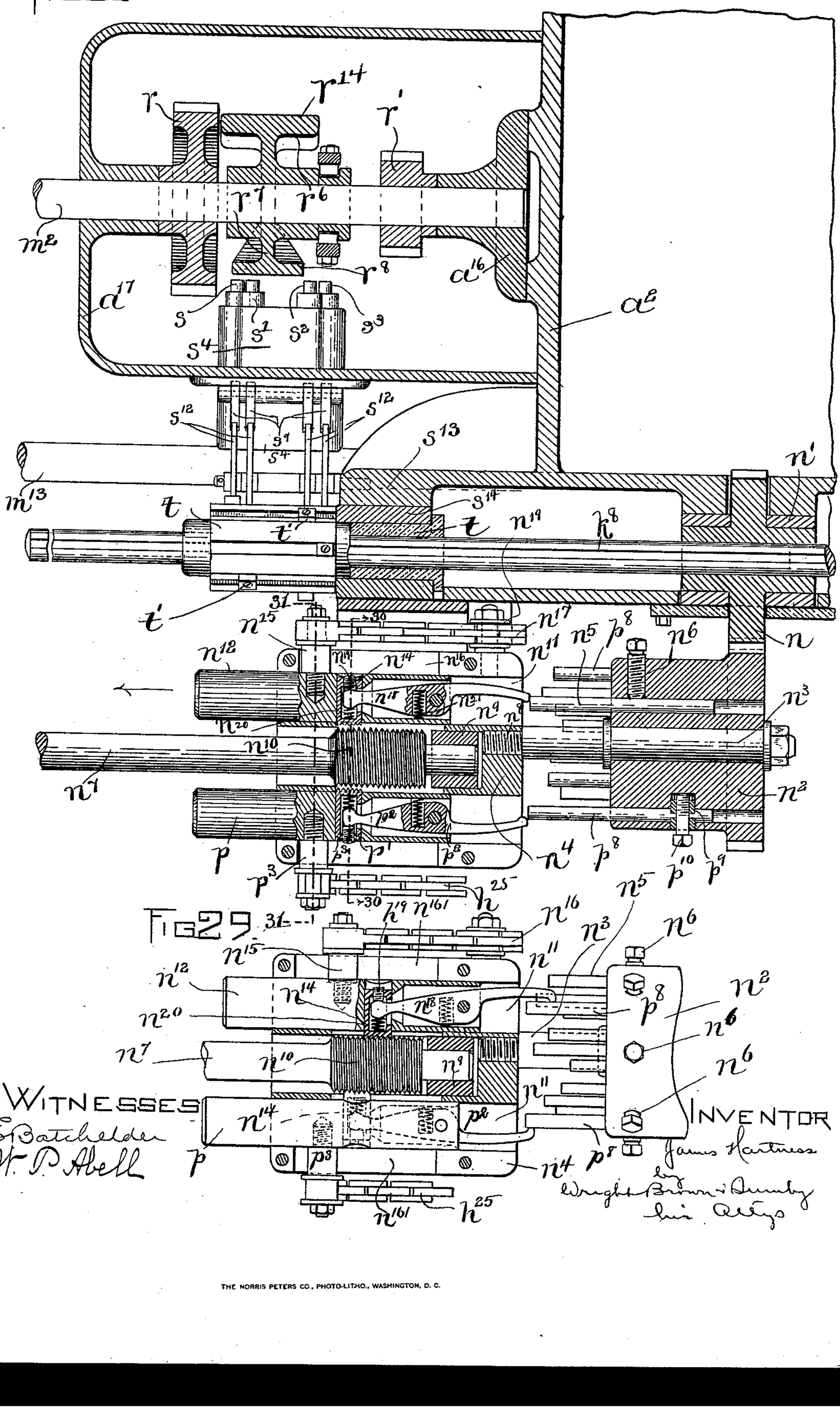

Fig 29

WITNESSES
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INVENTOR
James Hartness
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his Attys

No. 635,887.

Patented Oct. 31, 1899.

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TURRET LATHE.

(Application filed Aug. 31, 1898.)

(No Model.)

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FIG 32

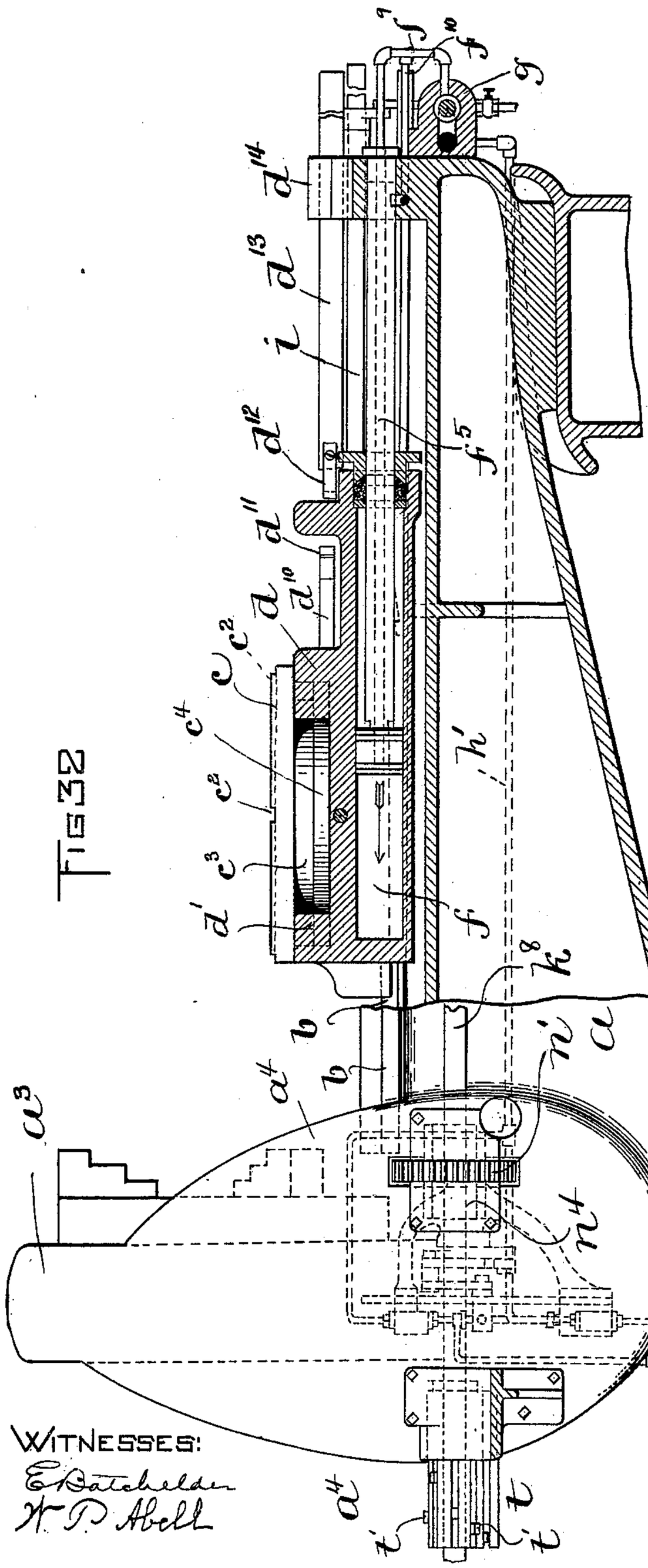
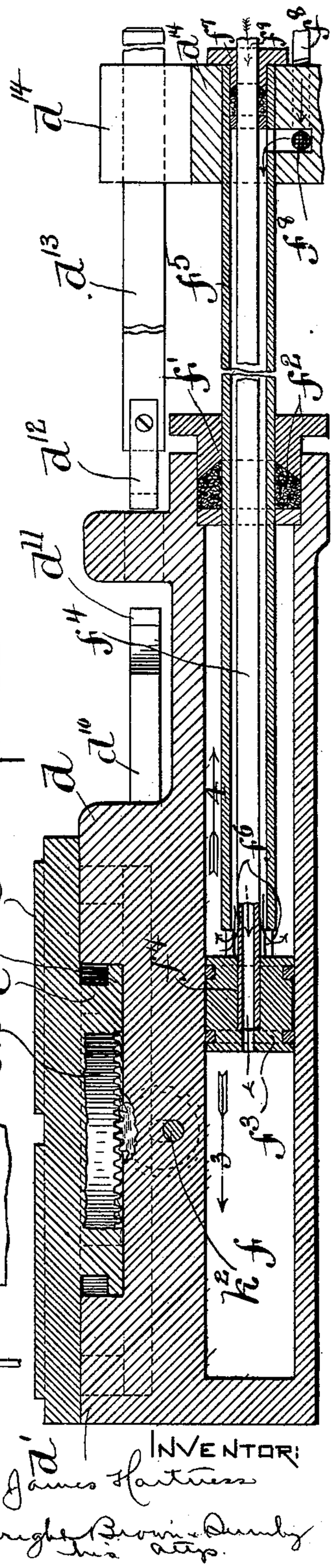


FIG 33



WITNESSES:

E. Batchelder

H. P. Abell

INVENTOR:

James Hartness

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No. 635,887. Patented Oct. 31, 1899.

J. HARTNESS.

TURRET LATHE.

(Application filed Aug. 31, 1898.)

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Fig. 40.

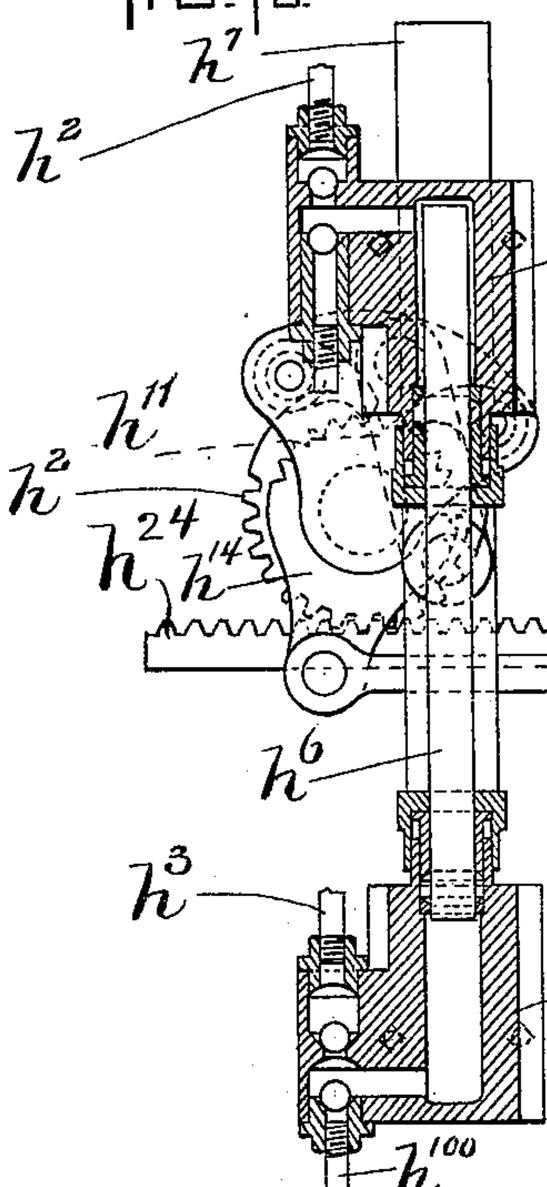


Fig. 41.

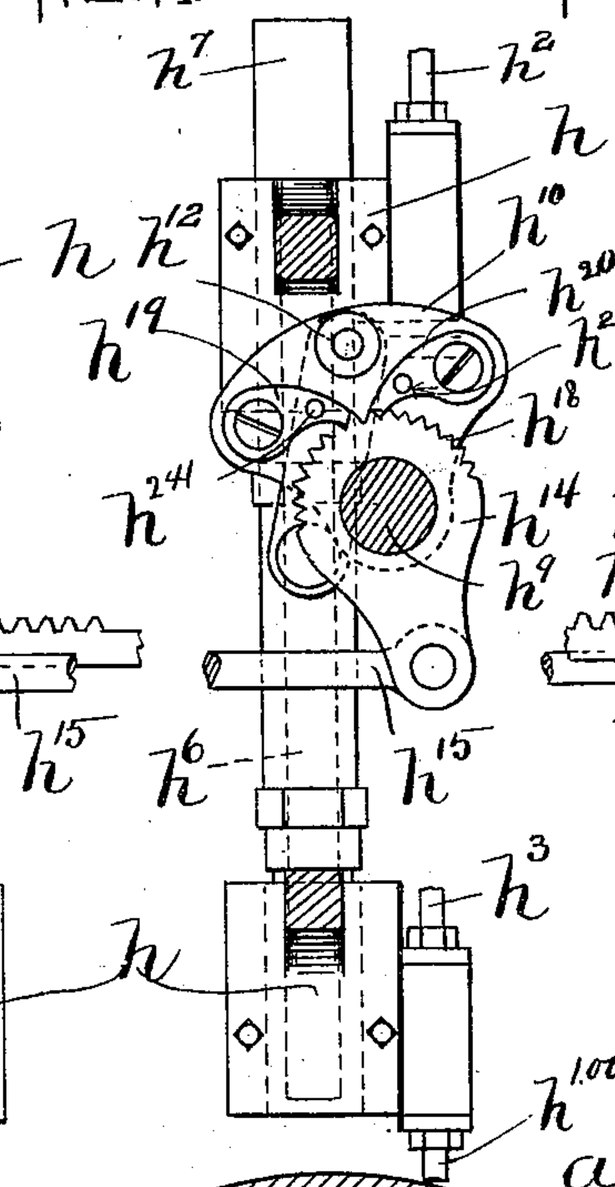


Fig. 42.

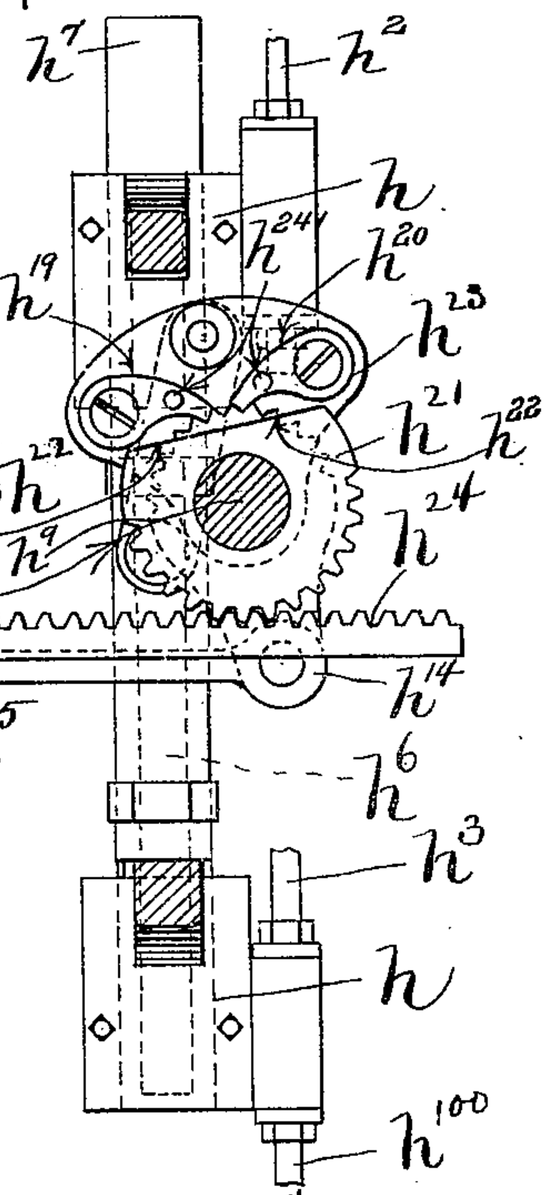


Fig. 44.

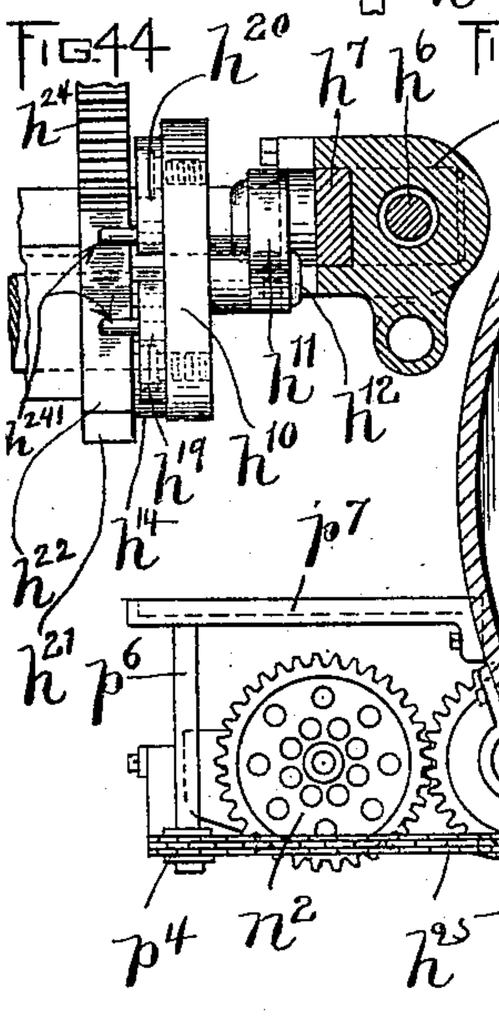


Fig. 34.

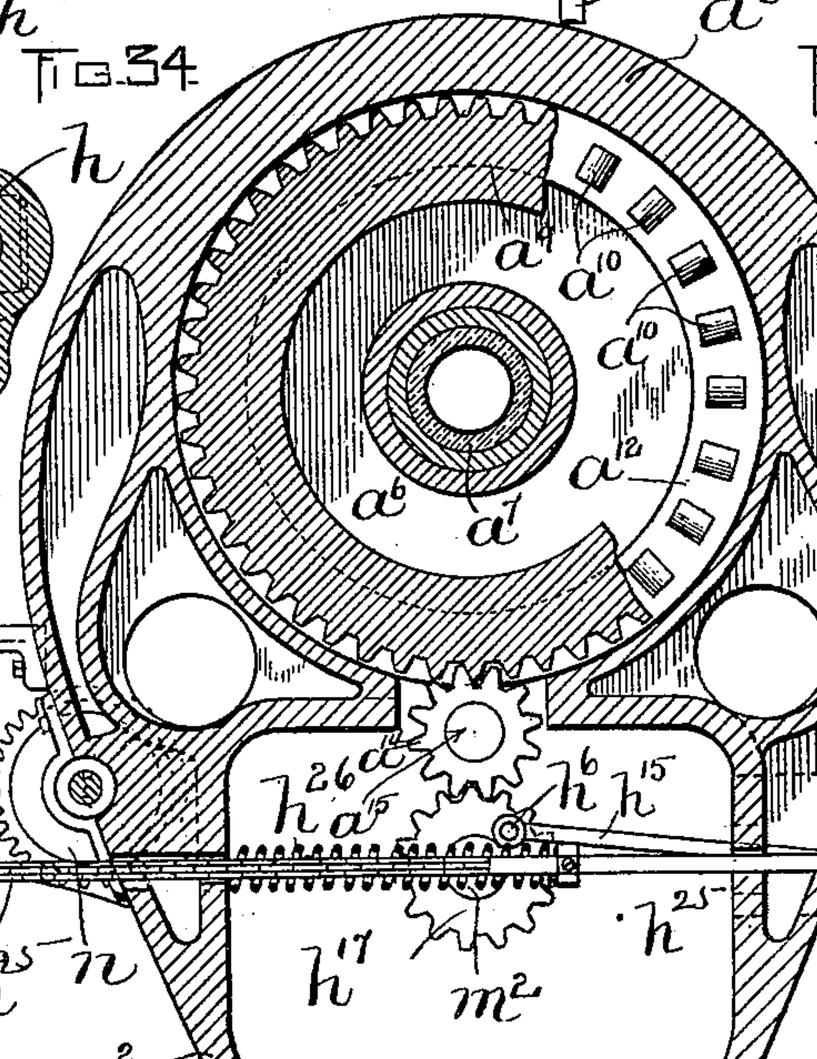
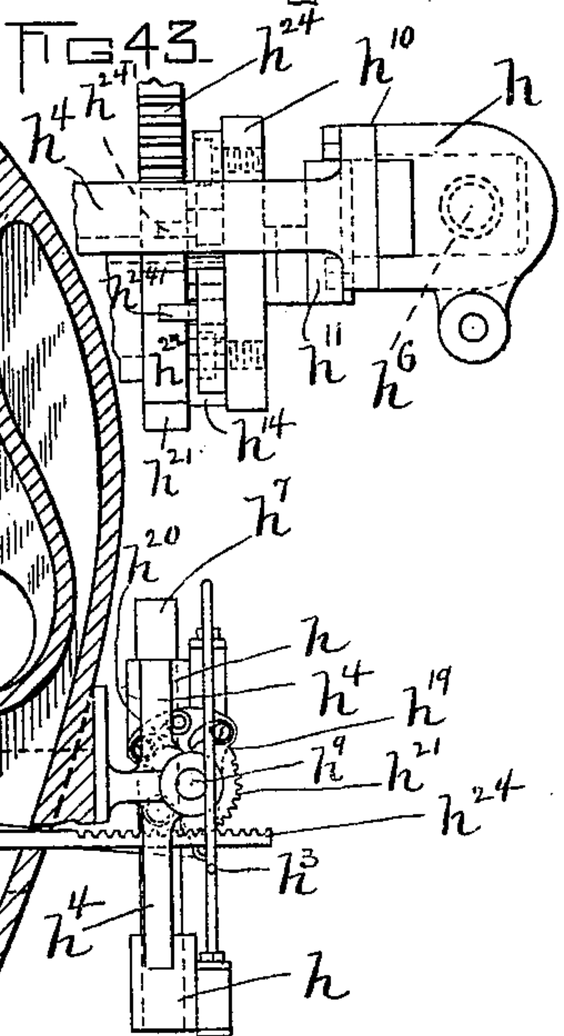


Fig. 43.



WITNESSES:
E. Batchelder
H. P. Abell

INVENTOR:
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No. 635,887. Patented Oct. 31, 1899.

J. HARTNESS.

TURRET LATHE.

(Application filed Aug. 31, 1898.)

(No Model.) 20 Sheets—Sheet 13.

FIG. 35

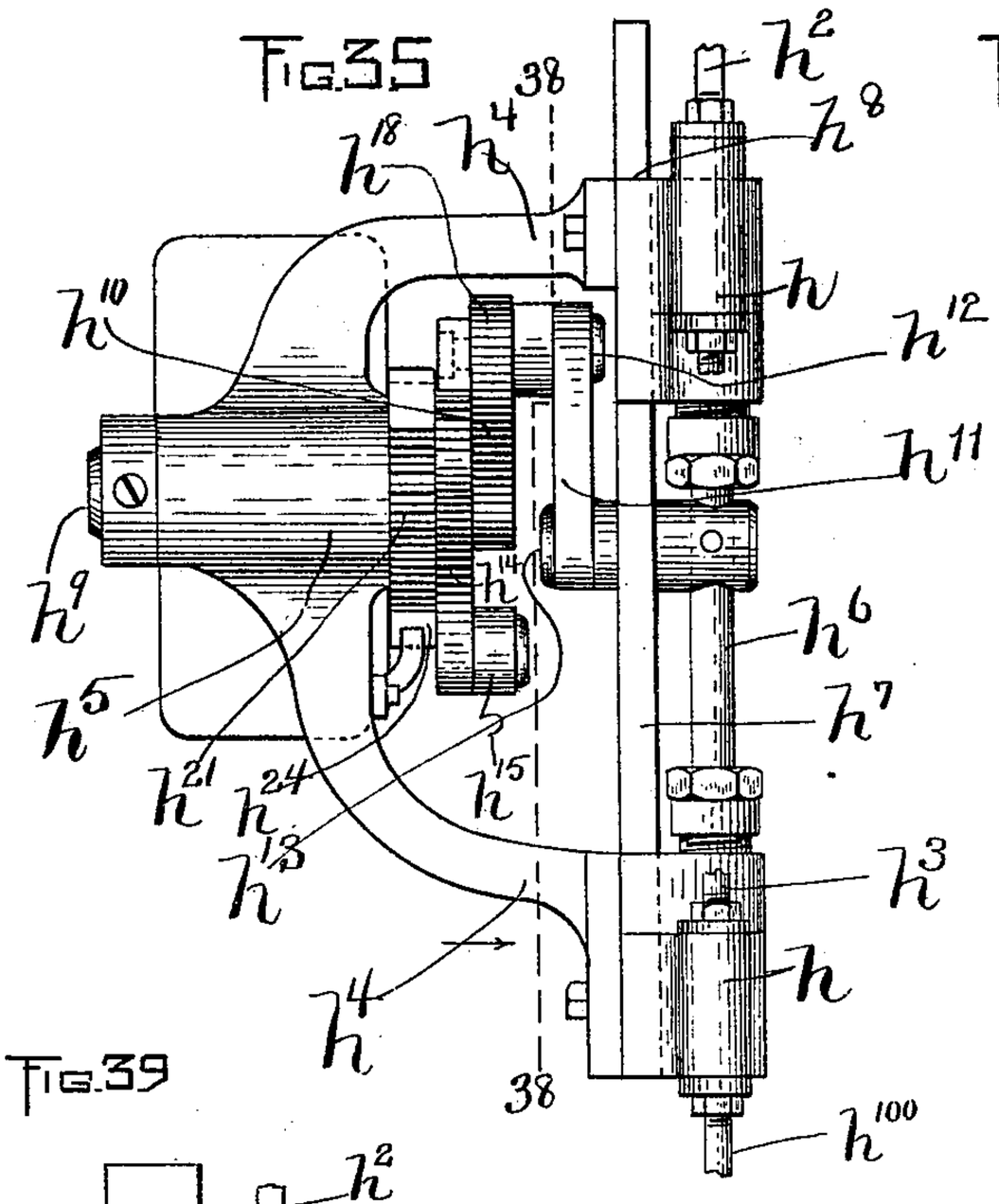


FIG. 39

FIG. 36

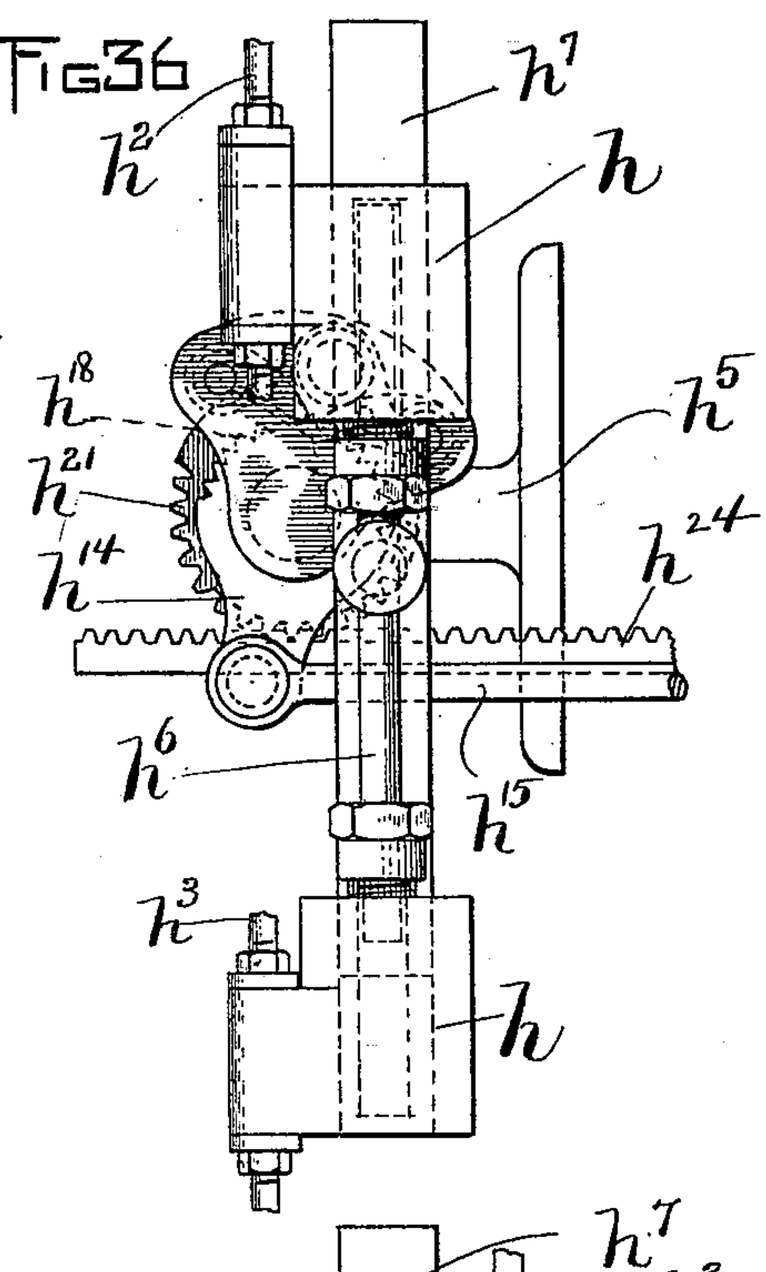


FIG. 38

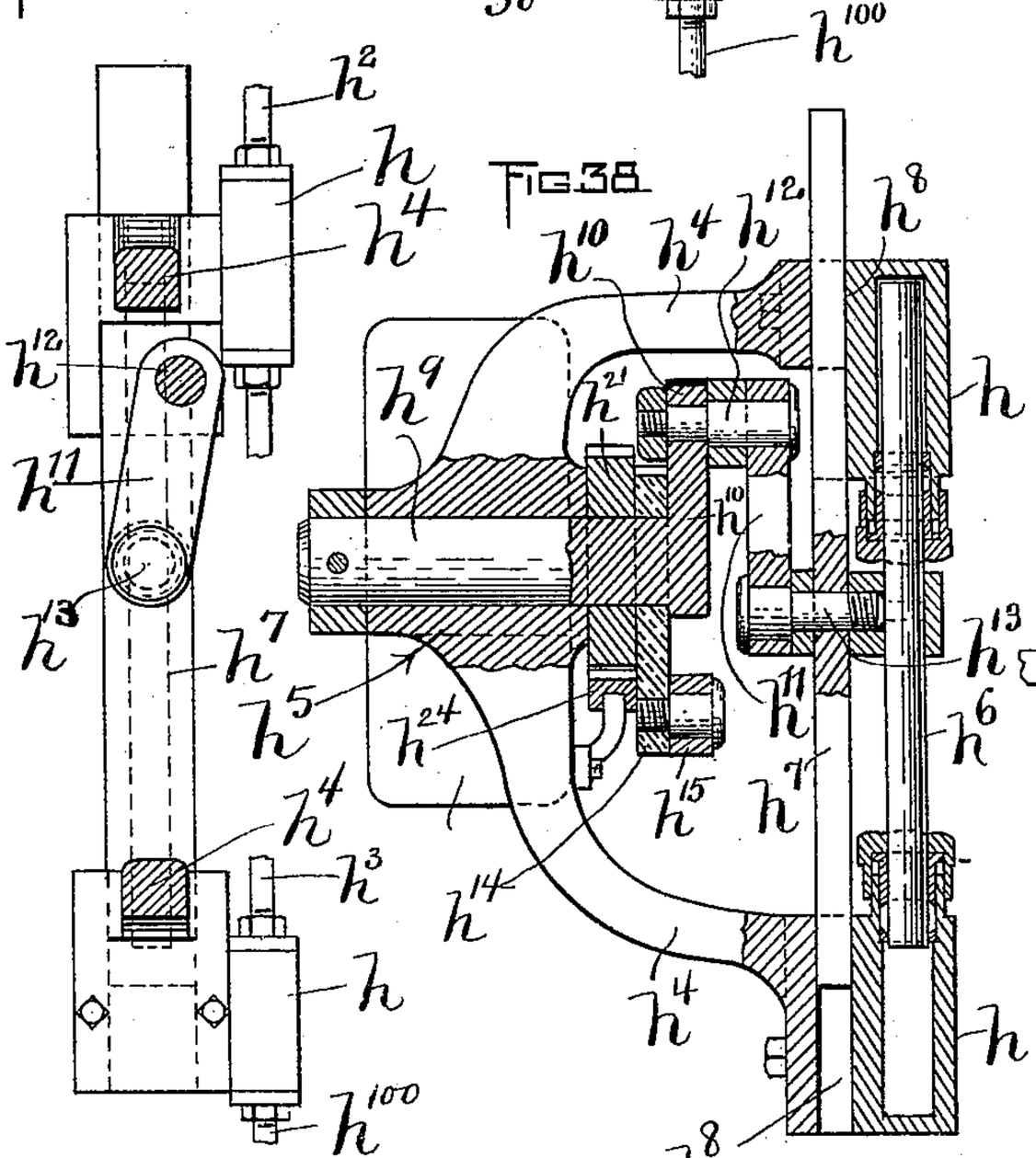
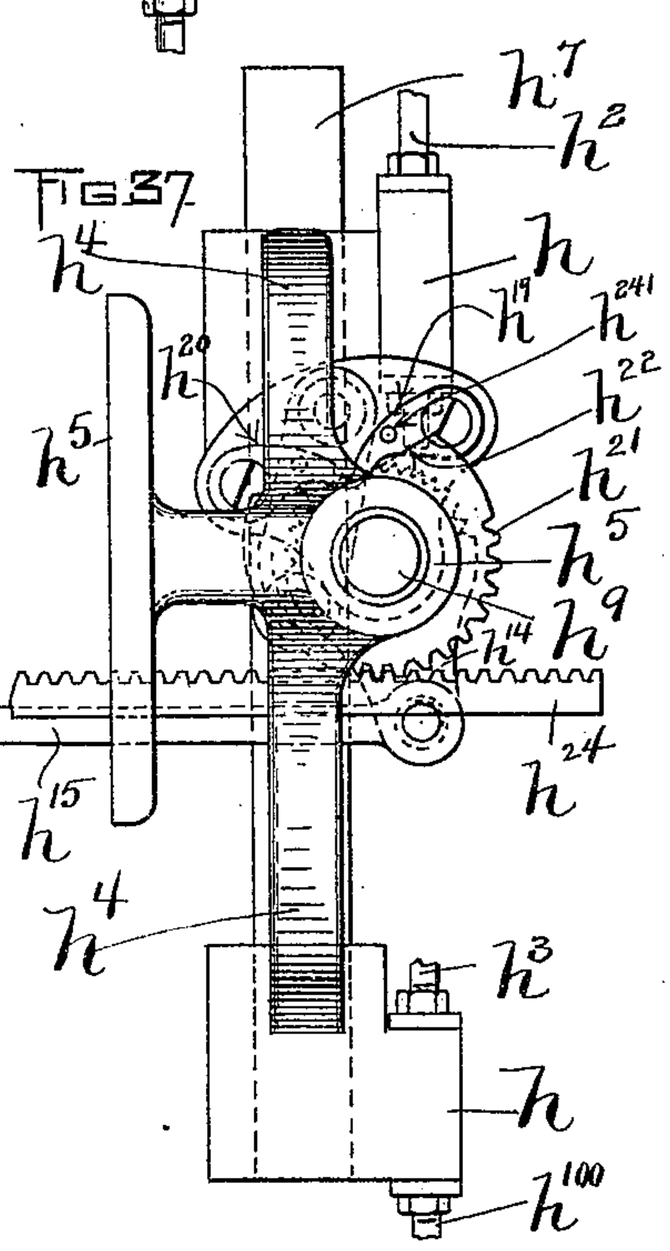


FIG. 37



WITNESSES
E. Batchelder
H. P. Hall

INVENTOR:
James Hartness
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No. 635,887.

Patented Oct. 31, 1899.

J. HARTNESS.

TURRET LATHE.

(Application filed Aug. 31, 1898.)

(No Model.)

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FIG. 45

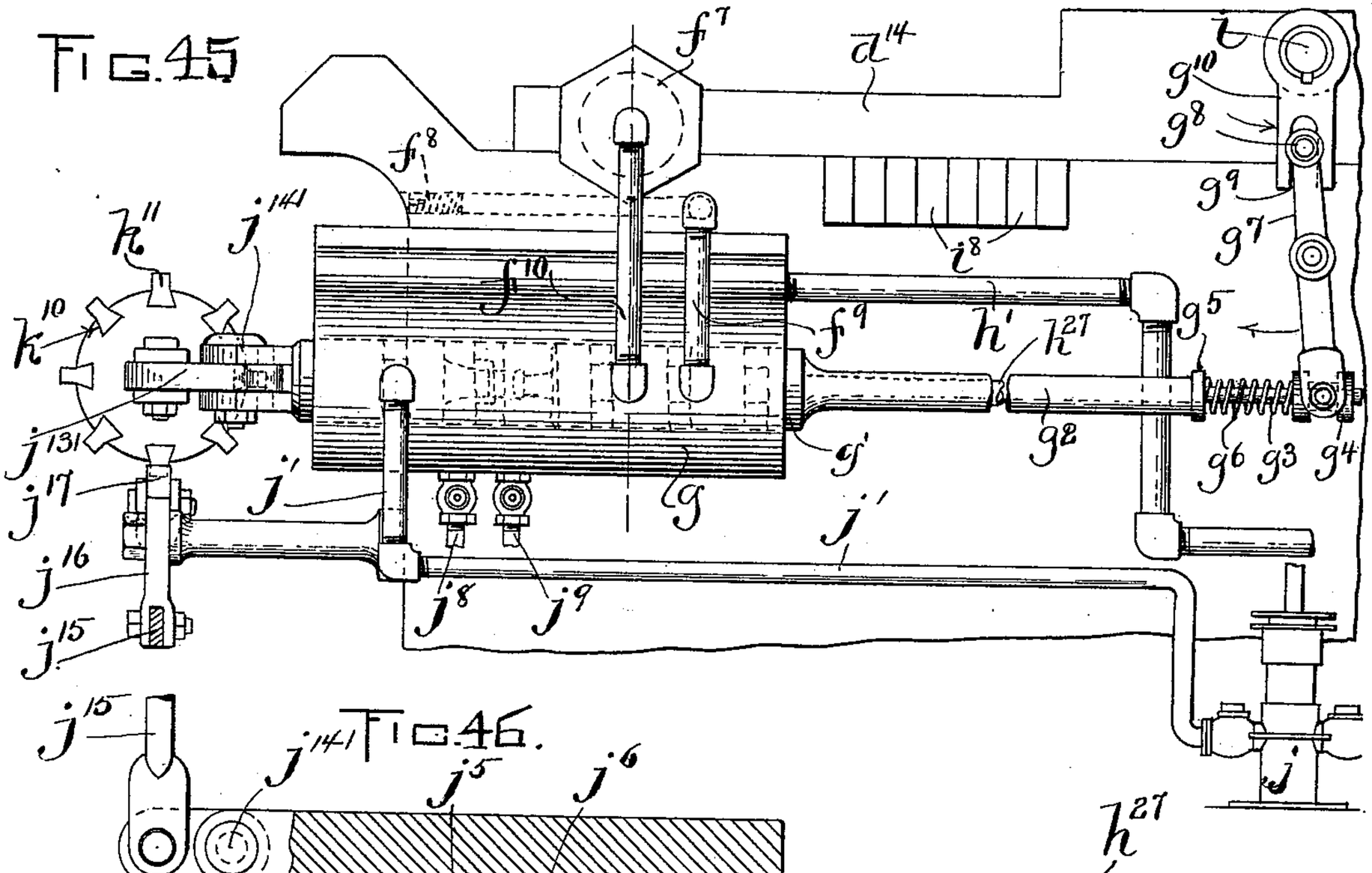

FIG. 46.

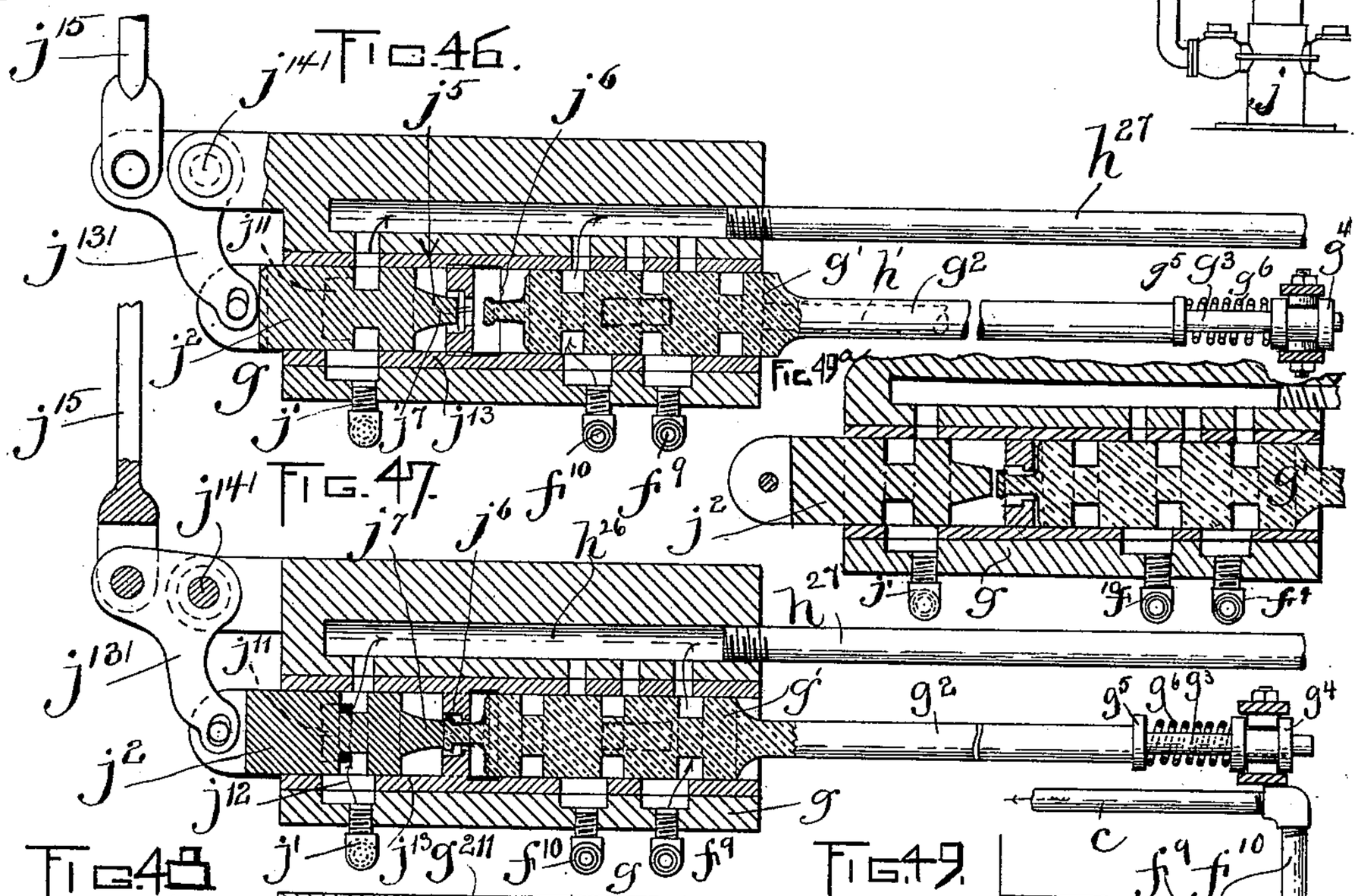

FIG. 47.

FIG. 48.

FIG. 49.

FIG. 49a.

WITNESSES:

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H. P. Abell

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No. 635,887. Patented Oct. 31, 1899.

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(Application filed Aug. 31, 1898.)

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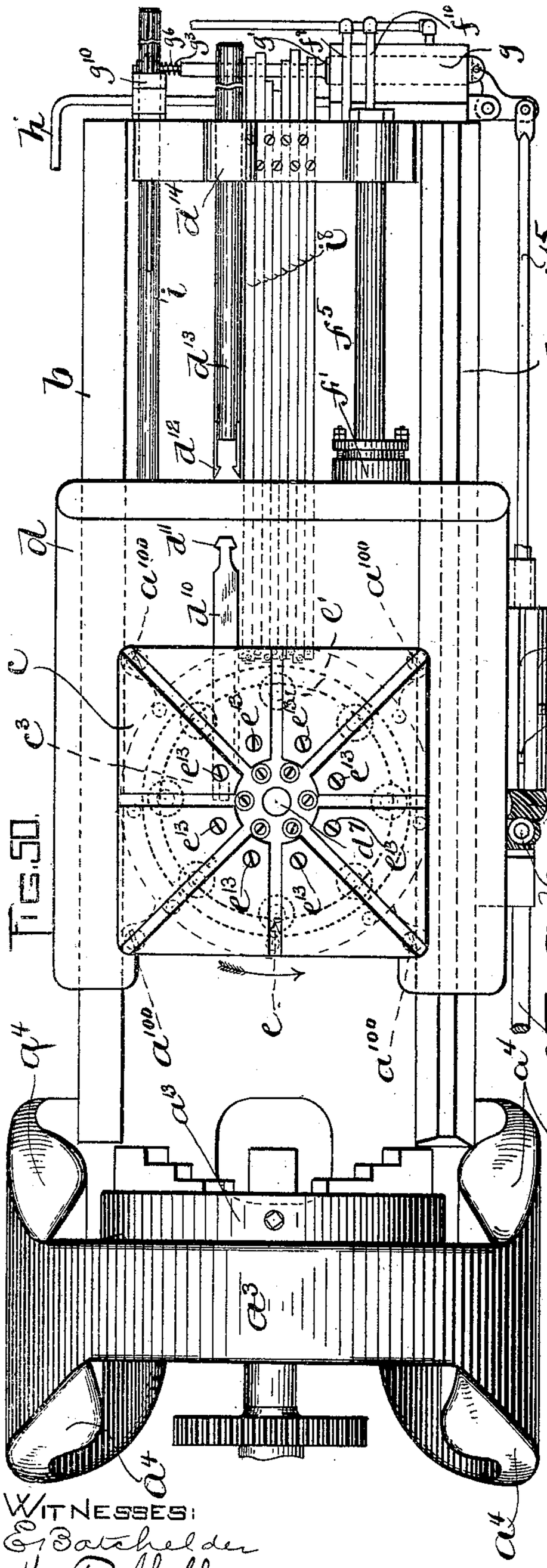

FIG. 50.

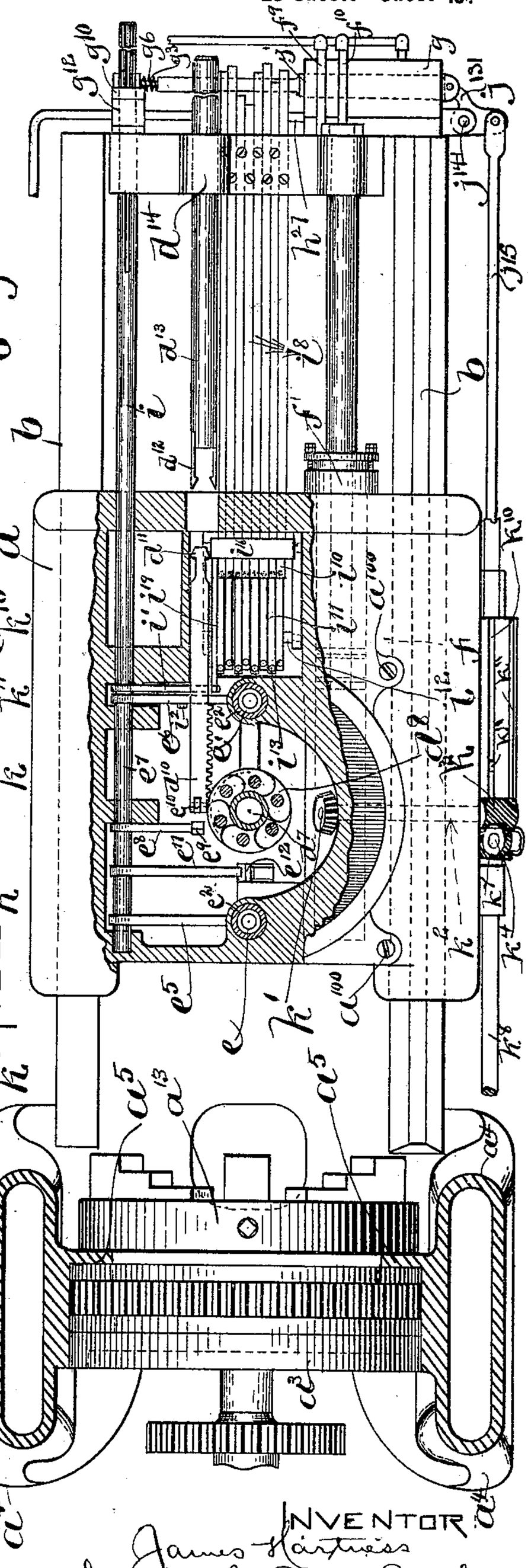

FIG. 51.

WITNESSES:
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No. 635,887. Patented Oct. 31, 1899.

J. HARTNESS.

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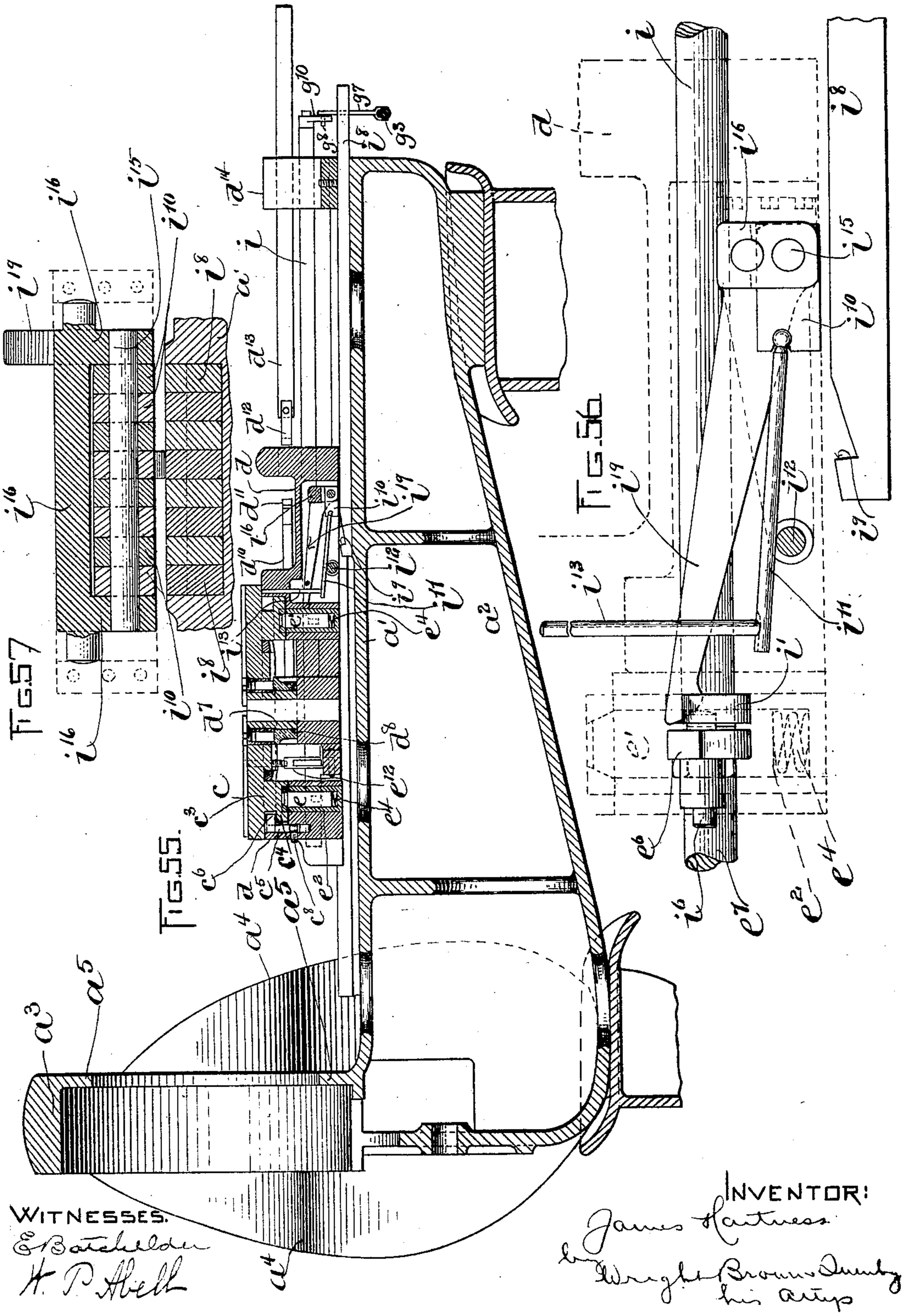
(Application filed Aug. 31, 1898.)

(No Model.) 20 Sheets—Sheet 16.



WITNESSES:
E. Batchelder
H. P. Hiell

INVENTOR:
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his attys

No. 635,887. Patented Oct. 31, 1899.

J. HARTNESS.

TURRET LATHE.

(Application filed Aug. 31, 1898.)

(No Model.) 20 Sheets—Sheet 17.

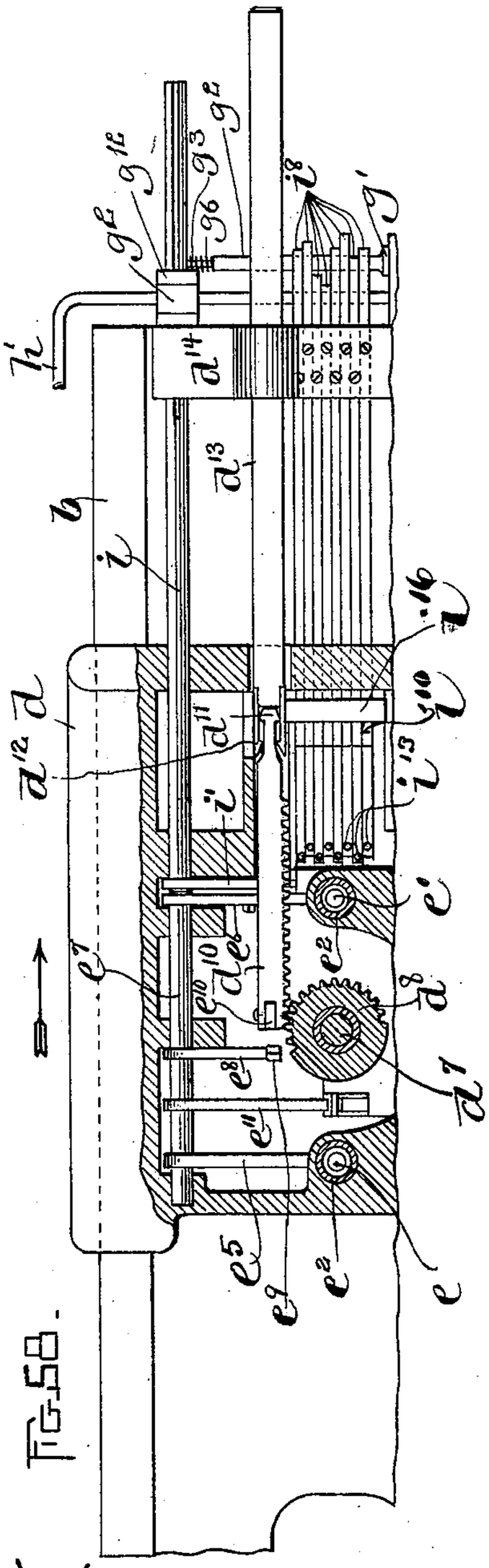

FIG. 58.

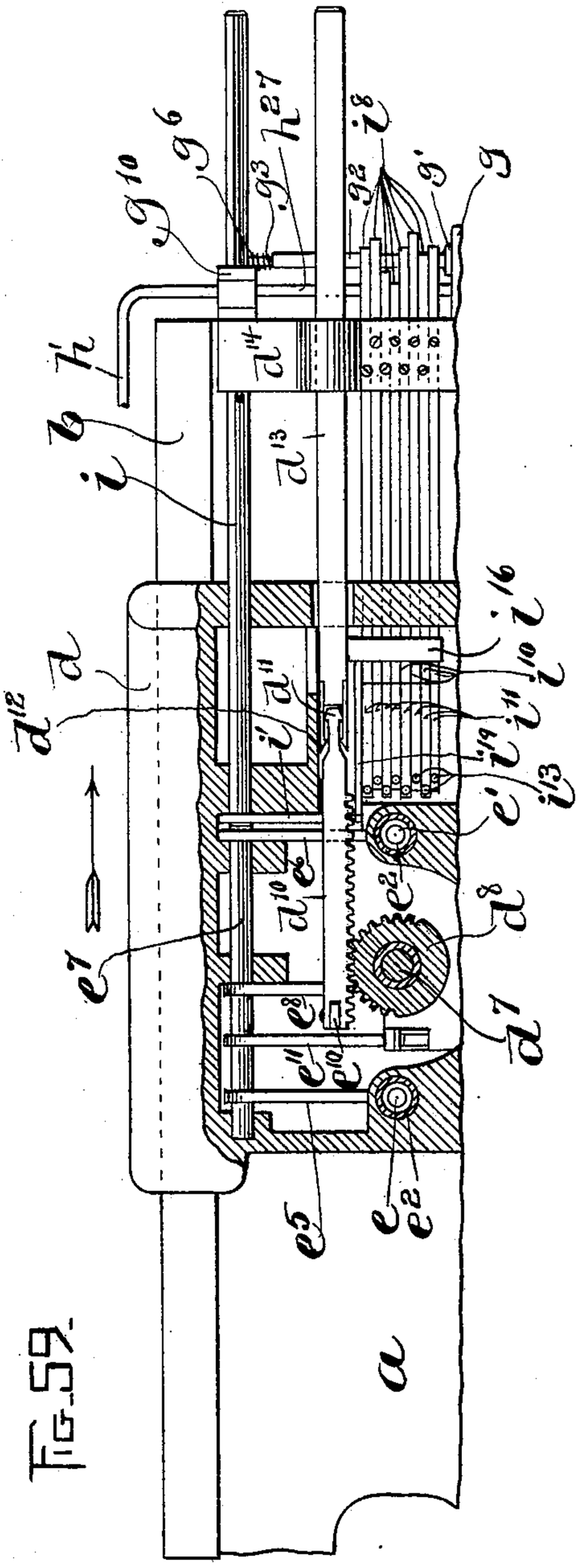

FIG. 59.

WITNESSES:
E. Batchelder
H. P. Abell

INVENTOR:
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by Dillingham Brown & Quinby
his attys

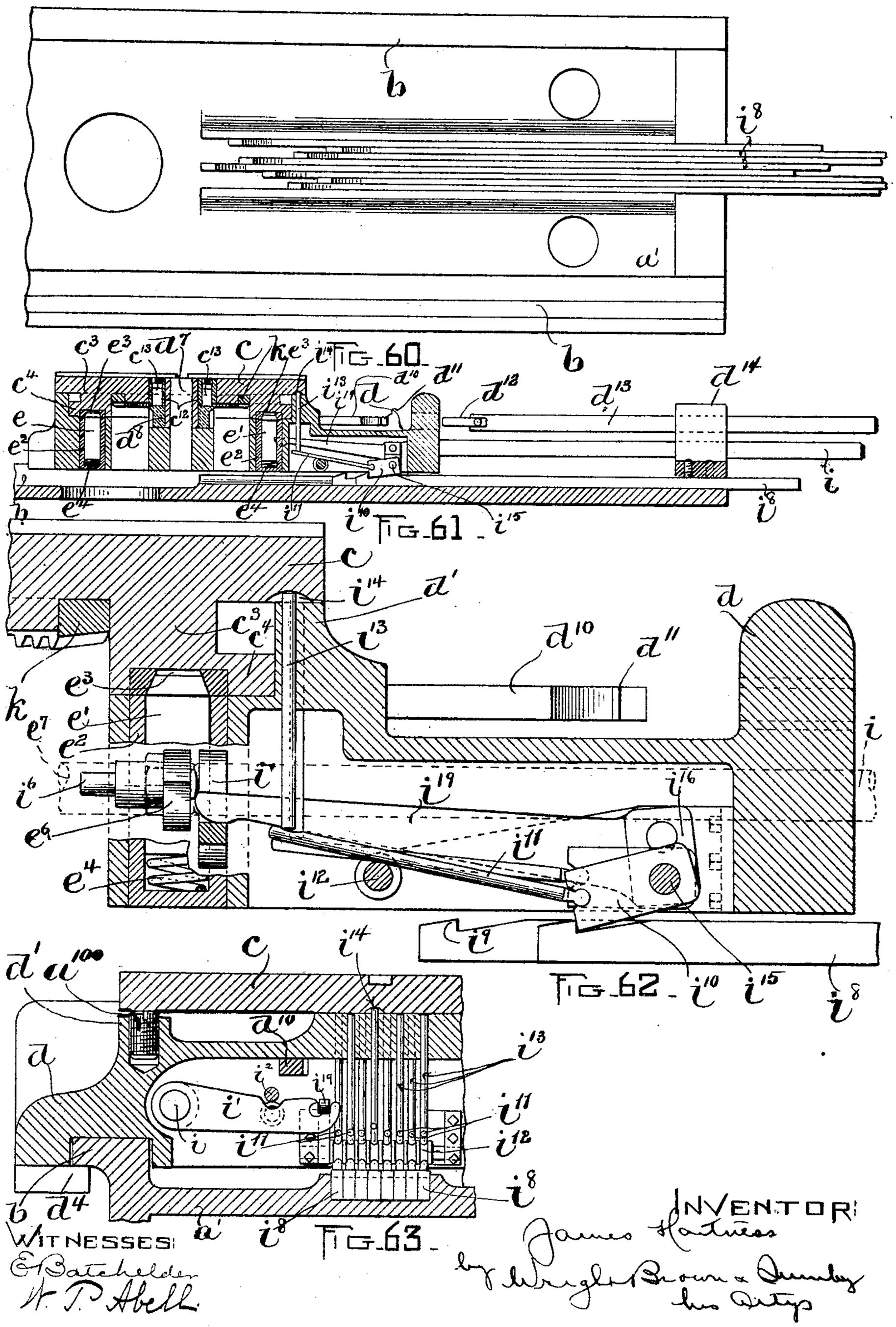
No. 635,887. Patented Oct. 31, 1899.

J. HARTNESS.

TURRET LATHE.

(Application filed Aug. 31, 1898.)

(No Model.) 20 Sheets—Sheet 18.



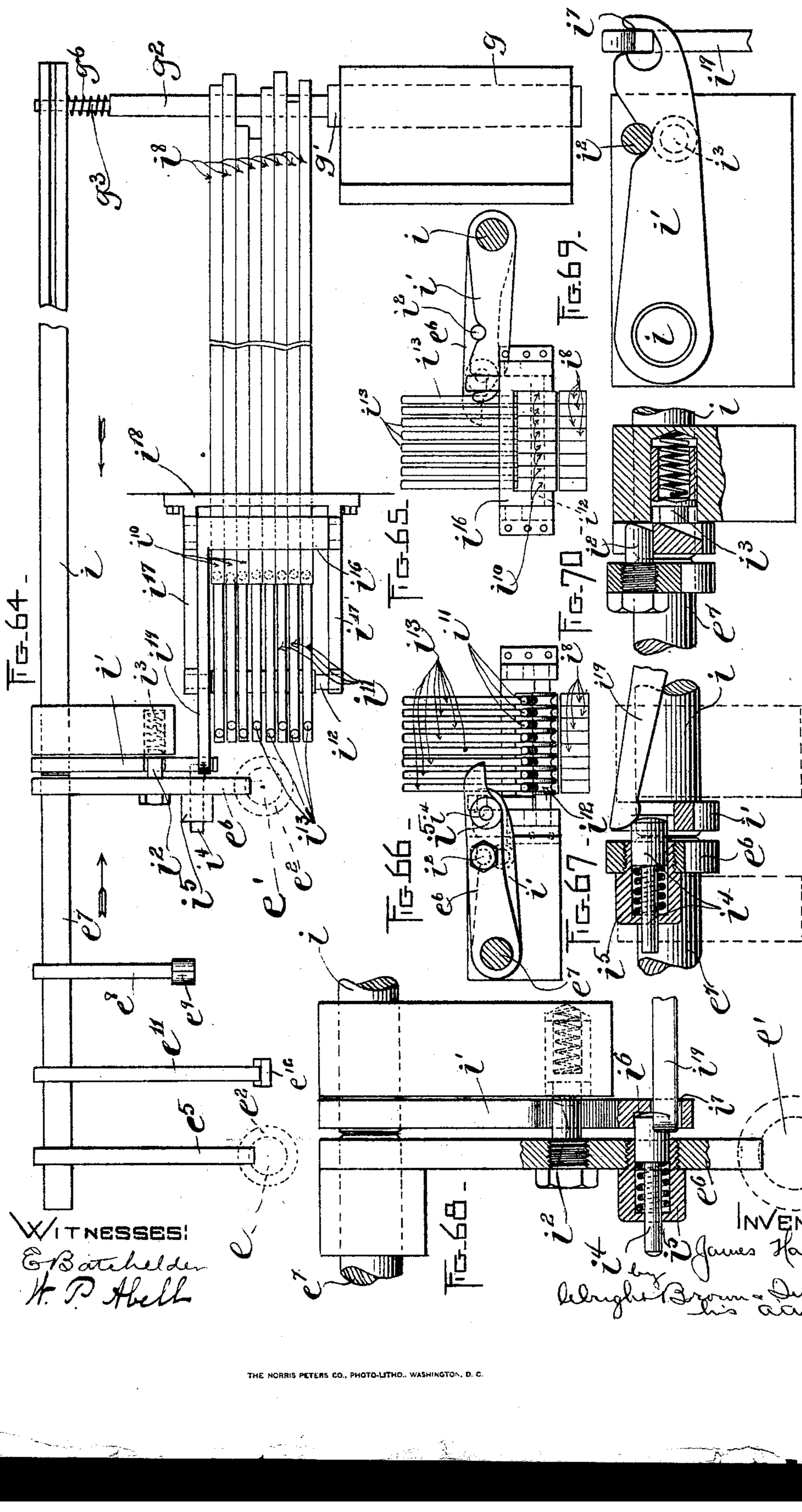
No. 635,887. Patented Oct. 31, 1899.

J. HARTNESS.

TURRET LATHE.

(Application filed Aug. 31, 1898.)

(No Model.) 20 Sheets—Sheet 19.



WITNESSES:
E. Batchelder
H. P. Abell

INVENTOR:
James Hartness
by Albright Brown & Quimby
his Attys

No. 635,887. Patented Oct. 31, 1899.

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TURRET LATHE.

(Application filed Aug. 31, 1898.)

(No Model.) 20 Sheets—Sheet 20.

FIG. 71.

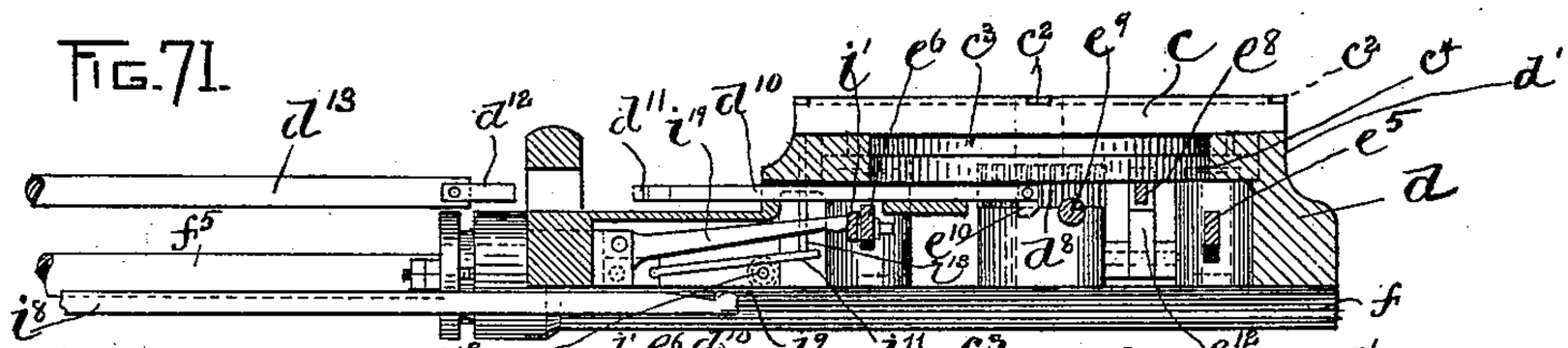


FIG. 72.

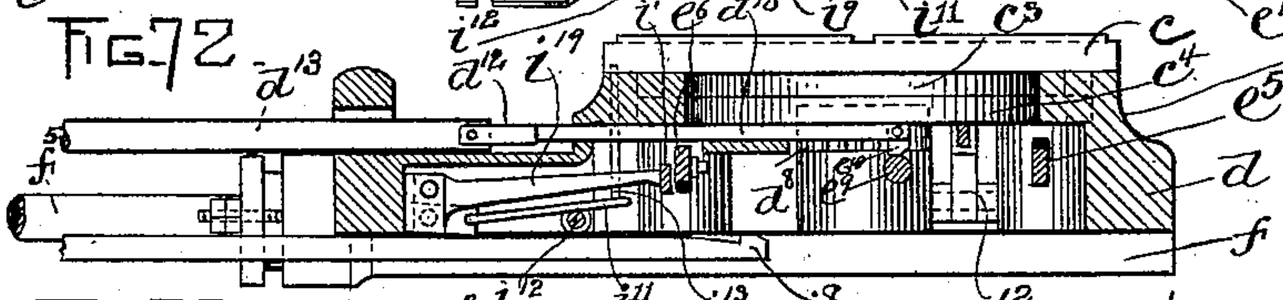


FIG. 73.

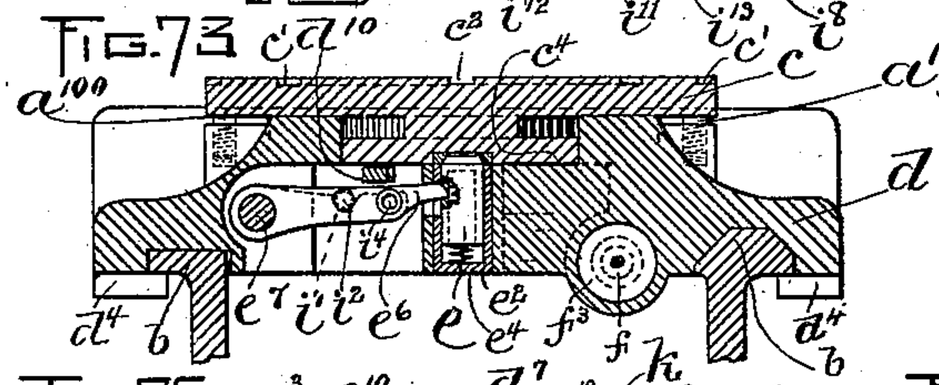


FIG. 74.

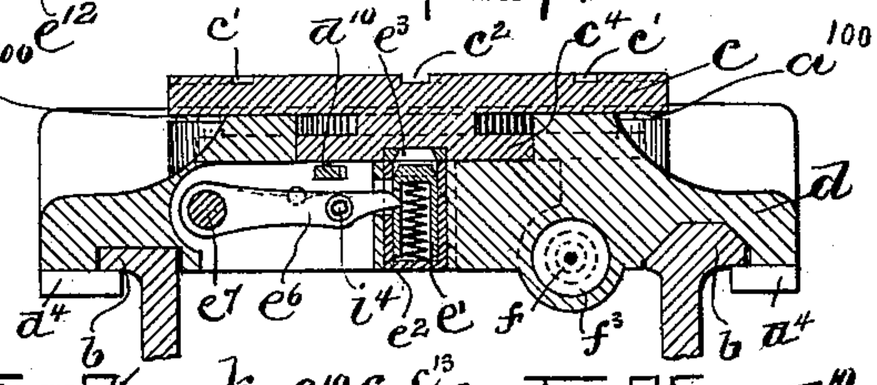


FIG. 75.

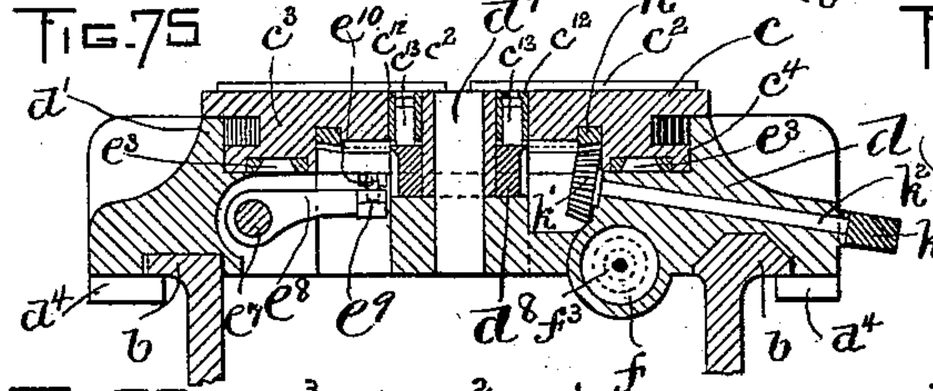


FIG. 76.

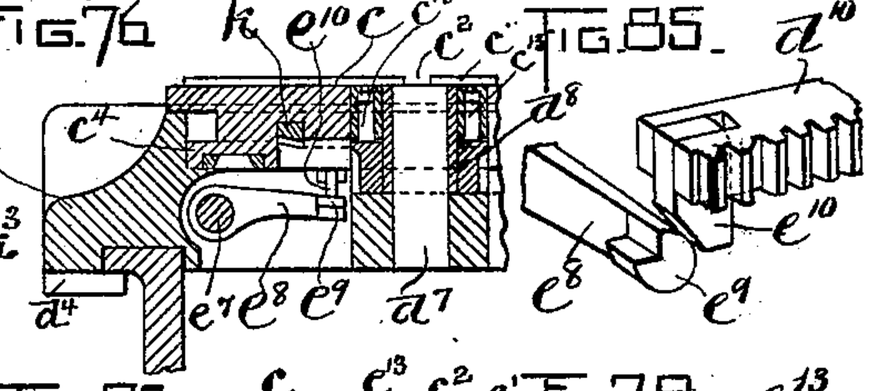


FIG. 85.

FIG. 77.

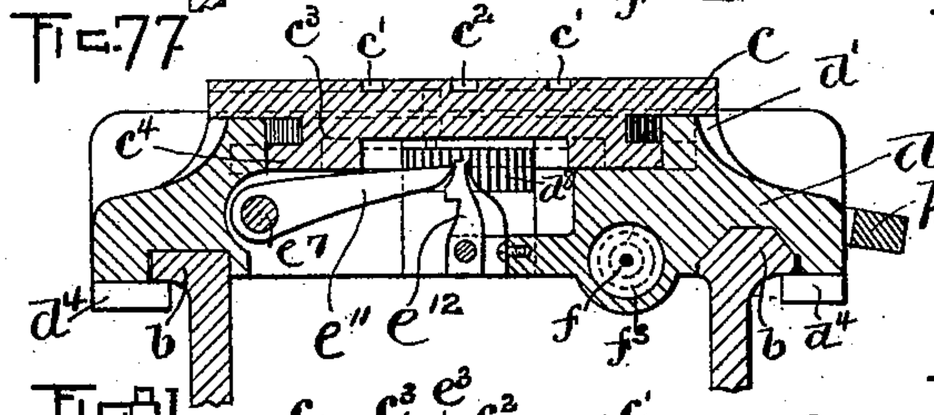


FIG. 78.

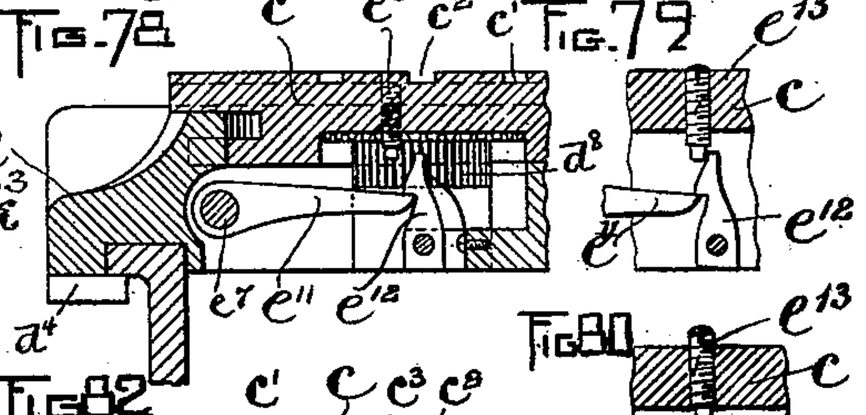


FIG. 79.

FIG. 81.

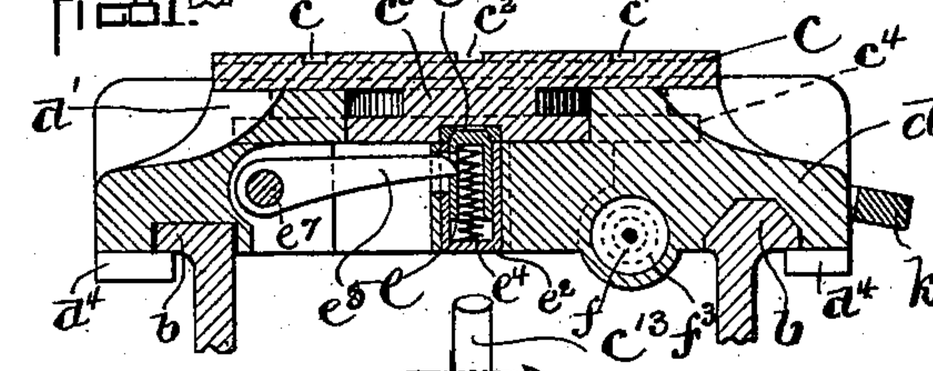


FIG. 82.

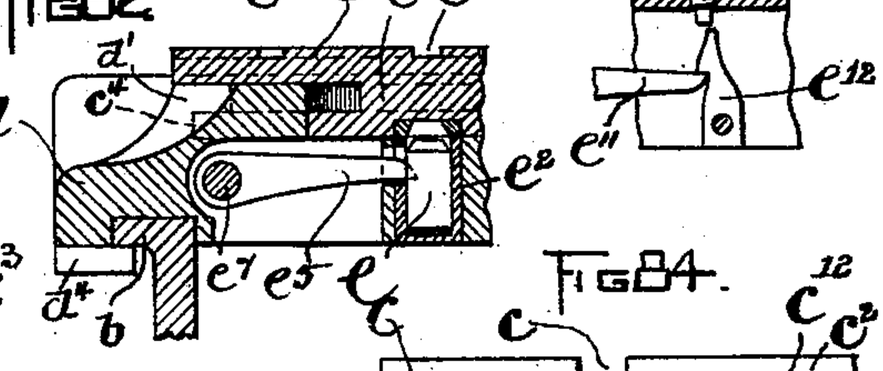


FIG. 80.

FIG. 83.

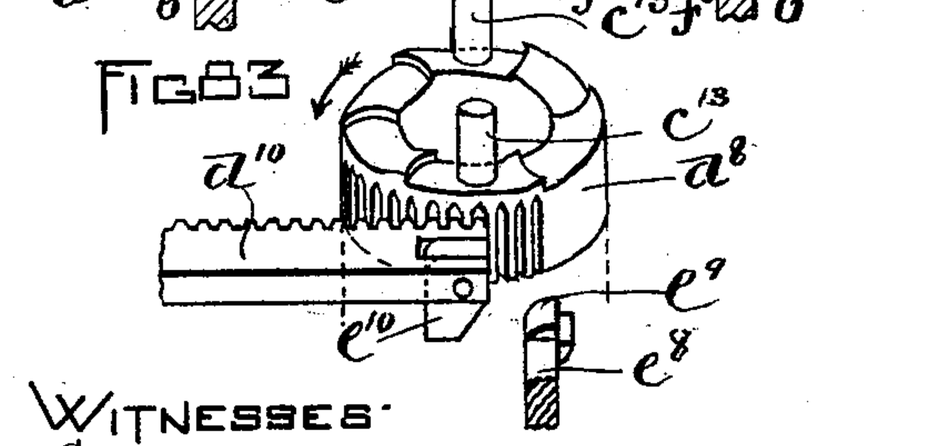
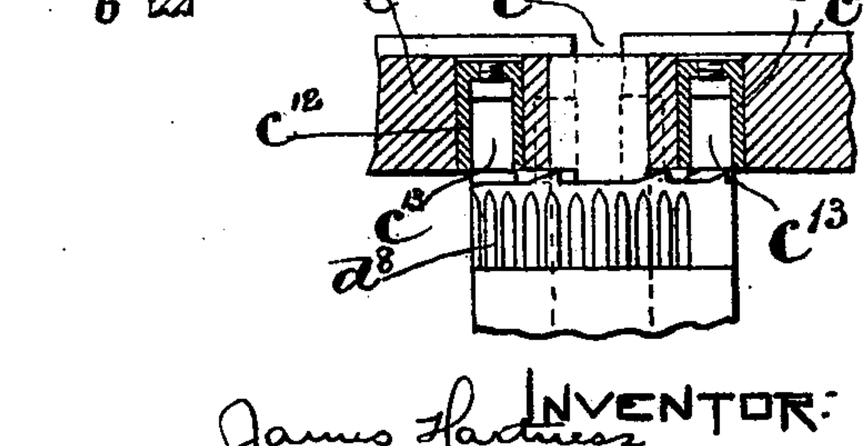


FIG. 84.



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by Dwight, Brown & Dumby
his attys.

UNITED STATES PATENT OFFICE.

JAMES HARTNESS, OF SPRINGFIELD, VERMONT.

TURRET-LATHE.

SPECIFICATION forming part of Letters Patent No. 635,887, dated October 31, 1899.

Application filed August 31, 1898. Serial No. 689,961. (No model.)

To all whom it may concern:

Be it known that I, JAMES HARTNESS, of Springfield, in the county of Windsor and State of Vermont, have invented certain new and useful Improvements in Turret-Lathes, of which the following is a specification.

This invention has relation to turret-lathes or screw-machines of the general character of that set forth in my Patent No. 457,967, dated August 18, 1891.

The object of the invention is to provide a machine of the class mentioned capable of performing chucking and turning operations and equipped with hand and automatic devices for causing the tools to operate upon the stock in proper succession and to the proper extent, whereby a piece of raw material may be properly turned and delivered as a finished article.

The invention has likewise for its object to provide a machine of this character which will automatically regulate the speed of rotation of the work, whereby it may be driven at a predetermined rate of speed regardless of the resistance caused by the engagement of the tool and the work and may be driven at different speeds, and also to equip the machine with mechanism for automatically advancing and withdrawing the turret rapidly toward and from the stock or work and feeding it slowly while the tool is performing its allotted duty.

Still another object of the invention is to provide other improvements in turret-lathes whereby there may be obtained a greater control over the work and tools, the work may be held rigidly against strains, a greater number of operating-tools may be attached to the turret than heretofore, the turret may be locked with greater rigidity in desired locations and properly indexed, and the machine itself rendered more accurate, durable, and efficient in operation than heretofore.

A further and important object of the invention is to provide controlling mechanisms for the various movable and operative parts of the machine, whereby they may be governed or controlled with a very slight effort on the part of the operator.

To these ends the invention consists of the machine and improvements which are fully illustrated upon the drawings and shall now be described in detail, and finally pointed out with particularity in the claims hereunto appended.

Reference is to be had to the accompanying drawings and to the letters of reference marked thereon, the same letters of reference indicating the same parts in all the figures.

Figure 1 represents in side elevation a turret-lathe embodying my invention. Fig. 2 represents a plan view of the same. Fig. 3 represents a plan view of the rear portion of the lathe, somewhat enlarged. Fig. 4 represents a front end elevation of the lathe. Fig. 5 represents an obverse view of the turret, which is removed from the carriage. Fig. 6 represents a plan view of the carriage with the turret removed. Figs. 7, 8, and 9 illustrate the devices for attaching the turret to the carriage. Fig. 10 represents a transverse sectional view of the turret, the carriage, and the bed, being a section on the line 10 10 of Fig. 13. Fig. 11 represents the end of the shaft which controls the movement of the valve, by means of which the flow of liquid into the carriage-moving apparatus is controlled. Fig. 12 represents the rear elevation of the lathe, the motor not being shown. Fig. 13 represents a front elevation of the rear end of the lathe, the casing or housing for the motor being illustrated in section. Fig. 14 represents a section on the line 14 14 of Fig. 16. Fig. 15 represents an end view of the water-wheel of the motor and one of the nozzles for discharging the liquid thereagainst. Fig. 16 represents a longitudinal section through the rear end of the lathe. Fig. 17 represents a section on the line 17 17 of Fig. 16, parts being broken away. Fig. 18 represents a section on the line 18 18 of Fig. 17. Fig. 19 represents a separating-ring for the rolls employed in the head-stock. Fig. 20 represents the gears and stop-carrier by means of which the clutch on the chuck-driving shaft is controlled, whereby the work-carriage is caused to be rotated in either direction or brought to a state of rest. Figs. 21 to 27 illustrate in detail the clutch-controlling devices. Fig. 28 represents a horizontal section through the rear end of the lathe and illustrates the clutch-controlling devices, the motor-controller, and the devices for control-

ling the volume of fluid delivered into the feeding devices for the turret-carriage. Fig. 29 represents another view of the controllers for the motor and the turret-carriage and feeding devices, showing them in positions different from those occupied by them in Fig. 28. Figs. 30 and 31 represent sections on the lines 30 30 and 31 31 of Fig. 28. Fig. 32 represents a front elevation, partially in section, of the forward end of the lathe. Fig. 33 represents a longitudinal section through the turret and the turret-carriage. Fig. 34 represents a transverse section through the head-stock. Figs. 35 to 44 represent the pump for forcing liquid into the cylinder in the carriage and the mechanism governed by the parts in Fig. 28 for automatically controlling the volume of liquid delivered by the pump to the carriage-feeding cylinder. Figs. 45 to 49, inclusive, represent the valve which controls the delivery of the liquid to the carriage-cylinder. Fig. 50 represents a plan view of the forward end of the lathe. Fig. 51 represents another plan view, partially in section, of the same. Figs. 52, 53, and 54 (see Sheet 5) are sectional views representing details. Fig. 55 represents a longitudinal section through the turret, the turret-carriage, and the bed of the lathe. Fig. 56 represents, somewhat enlarged, the tappet-rods, the mechanism for stopping the forward movement of the turret-carriage, and the device for unlocking the turret from the carriage to permit it to rotate. Figs. 57 to 85, inclusive, represent details of the same, together with mechanism operated thereby or coacting therewith.

Referring to the drawings, which show one embodiment of the invention which I have selected for the purpose of illustration and disclosure, a indicates the bed of the lathe, which is mounted upon suitable legs or supports and is provided with ways or shears $b\,b$, upon which the carriage d travels lengthwise thereof.

The rotating plate-shaped turret c is mounted upon the carriage d and is arranged to receive a series of cutters or other operating-tools which are adapted to be brought successively into position to act upon the stock or material held in the chuck.

The bed of the lathe is hollow and has a peculiar shape, having a flat top or table-like portion a', upon which the ways are supported, and the under portion a^2, which slants downwardly from the forward end toward the rear, as shown in Figs. 1 and 55, the bed as a whole being substantially wedge-shaped. At its head end it is provided with the head-stock or bearing-ring a^3, which rises from the horizontal portion a' and laterally from which are extended two wings $a^4\,a^4$, as best shown in Figs. 50, 51, and 55. In side elevation the said wings are irregular in form, but approach the shape of an oval, being extended longitudinally of the machine to form a housing for the chuck and the chuck-carrier, which may be either a spindle or the devices hereinafter described.

Besides covering and protecting some of the moving parts of the lathe, as well as the ways beyond which it projects, the housing forms a firm support for the head-stock a^3. The said bearing-ring or head-stock is provided with an internal flange or gib a^5, and secured in the said ring forward of the flange is a stationary plate a^6, having a central rearwardly-projecting annular hollow flange or hub a^7. A circular plate or chuck-carrier a^8 is journaled upon the hub a^7, with its face flush with the outer surface of the flange or gib a^5, being formed with a flange a^9, having gear-teeth and overlapping the said flange or gib a^5. Rolls $a^{10}\,a^{11}$, placed in separator-rings $a^{12}\,a^{12}$, are inserted between the flange a^9 and the gib a^5 on the one side and the plate a^6 on the other side, whereby when the chuck-carrier or gear a^8 is rotated it is held against endwise movement and angular strains. The chuck (indicated as a whole at a^{13}) is rigidly secured to the said carrier. In order to compensate for wear, a frusto-conical bushing is inserted between the hub a^7 of the bearing-plate a^6 and the forwardly-projecting hub of the chuck-carrier, said bushing being adjusted by screws passed through the plate a^6 and bearing against its end. The chuck-carrier being in the form of a plate, with a bearing at or near its center and end-thrust bearings at or near its rim, is held against eccentric and endwise movement and is abundantly able to withstand angular strains. It is adapted to receive such work and stock as pulleys, cylinder-heads, &c., and is provided with the central aperture for receiving back facing-tools having special attachments to operate, for instance, on the inner end of a pulley-hub. It will be noted that I employ cylindrical rolls and confine them in separator or retaining rings, whereby I am enabled to prevent their wedging between the rotary and the stationary parts.

The chuck-carrier may, so far as certain other features of the invention hereinafter described are concerned, be in the form of a spindle and be mounted in any suitable bearings in the head-stock; but, as illustrated and described herein, its peripheral teeth intermesh with a pinion a^{14} on the end of a shaft a^{15}, whereby when power is transmitted to the shaft from a motor, to be described, the chuck-carrier and the stock therein are rotated. The chuck-driving shaft a^{15} is journaled at one end in a bracket a^{16}, secured to the rear end wall of the bed, and at the other end in a housing a^{17}, attached to the bed and covering the gearing, to be subsequently described.

The mechanism for rotating the shaft a^{16} I shall hereinafter describe in detail; but inasmuch as it is controlled or regulated by the movements of the turret I shall describe the latter first.

Referring to Figs. 2 and 5 to 10, inclusive, and Figs. 32 and 33, the turret c is shown as plate-shaped and square in plan view, with four intersecting grooves in the upper surface there-

of. Two of the grooves c' c' are arranged diagonally and extend from corner to corner, while the other two, c^2, extend across the top of the turret diametrically, all of the said grooves intersecting at the center. Thus there are provided eight short grooves c' c^2, extending radially outwardly from the center of the turret, to receive the box or other operating-tools, which may be placed thereon and secured to the top of the turret by bolts or any other suitable fastening devices. Four of the grooves c^2 are comparatively short, while the diagonal grooves c' are considerably longer, whereby I am enabled to secure to the top of the turret a greater number of operating-tools than heretofore, since the tools can be placed at different distances from the center of the turret and do not therefore interfere with one another.

It is evident that other well-known means for securing the tools to the turret may be employed in lieu of the grooves, though I prefer the latter in some cases. The square shape of the turret provides four edges which are substantially equal in width to the chuck and along any one of which one or more tools can be secured to the top of the turret, and it is likewise evident that it is within the scope of my invention to provide the turret with a single edge, instead of four, or any other desirable number of edges.

The turret is formed with a central aperture into which is driven a downwardly-projecting stud d^7, fitting loosely into the carriage, and the turret is provided with a cylindrical boss c^3, with an outwardly-extending flange c^4, which in plan view is located within the edges of the top portion of the carriage, as shown in Fig. 2. The carriage d, as shown in Fig. 6, is provided with an upwardly-projecting annular flange d', upon which the upper portion of the turret rests and into the cylindrical aperture in which the center pin of the turret fits, as shown in Fig. 10. To hold the turret against upward movement caused by angular strains, I provide a series of gibs or securing devices each consisting of a pin c^5, having a crescent-shaped head c^6 and a V-shaped groove c^7 at its lower end. The ring d' is recessed at d^2 to receive the said heads c^6, the shanks of the pins extending down into sockets d^3 therein and lying outside of the flange c^4. When the pins are in place, they are locked by horizontally-arranged studs c^8, engaging the lower walls of the grooves c^7, and screws c^9, bearing against the ends of the studs and driven horizontally into the edges of the carriers. The heads c^6 of the pins overlap the flange c^4 or take into the groove formed by the said flange, as clearly illustrated in Figs. 7 and 8, whereby the turret is free to rotate. When the turret is secured in place in this way, it is practically impossible for dust or dirt to have access to the engaging parts of the turret, the carriage, and the pawls or to accumulate in recesses between the parts, as the turret rests upon the ring or flange d', which forms a housing for this purpose. To support the corners of the square top portion of the turret, I employ adjustable studs or screws a^{100} driven into the top of the carriage.

The carriage for the turret is oblong in shape, as illustrated in Figs. 2 and 6, and it is provided with grooves to receive the ways or shears b of the bed a. Guide-strips or gibs d^4 are secured to the carriage and project underneath the ways b to prevent the carriage from being displaced, and to protect the shears from cuttings or fillings tubular casings or covers d^5 d^6 are attached to the ends of the carriage and partially encircle the ways, as shown in Fig. 4. I term the covers for the ways "shear-protectors," and it will be seen that the front protectors pass freely through apertures in the side wings a^4 in the head-stock or front end of the bed, as shown in Figs. 4, 17, and 34.

Journaled upon the stud or flange d^7 is a pinion d^8, having curved ratchet-teeth on its upper face, as shown in Figs. 51 and 83, and arranged in a circle in bushings c^{12} in the turret are cylindrical pawls c^{13}, one for each tooth in the pinion. By rotating the pinion in the direction of the arrow in Fig. 83 the turret will be rotated with it, whereas the rotation of the pinion in the opposite direction will have no effect upon the turret.

Intermeshing with the pinion d^8 is a rack d^{10}, (see Fig. 51,) which is arranged longitudinally of the carriage and is adapted to slide in suitable guides therein. This rack and gear are adapted to have a limited movement before the ratchet-teeth on the pinion reach their respective pawls. The rear end of the rack is substantially in the shape of an arrow-head d^{11}, and when the carriage approaches the end of its rearward movement it slips between spring-latches d^{12} on the end of a bar d^{13}, mounted upon the cross-bar d^{14} on the bed a, and, abutting against the end of the bar, is held against movement.

When the end of the rack-bar engages the bar d^{13}, the continued movement of the carriage causes it to rotate the pinion, which in turn rotates the turret to bring a new tool into operative position, and when the carriage starts forward toward the chuck the rack-bar d^{10} is engaged by the spring-latches d^{12} until the pinion d^8 has been returned to normal position, after which the arrow-head d^{11} slides out from between the spring-latches d^{12}, as shown in Figs. 2 and 51, and the rack is carried forward with the carriage.

To hold the turret with great rigidity against movement while the tool is operating upon the work or stock in the chuck, I provide locking-dogs or index-pins e e', which are two in number and are mounted in bushings e^2 in the carriage in the front and rear of the pivot-studs d^7, said pins being normally thrust up-

ward to engage sockets e^3 in the downwardly-projecting portion of the turret c by springs e^4, placed beneath them.

Heretofore only one index-pin was employed; but inasmuch as the center pin d^7 soon wore loose from the rotation of the turret the latter was not properly centered and held against vibration. Consequently by employing two diametrically opposite index-pins the exact rotative position of the turret and the location of the center are determined with great nicety and a greater resistance to the strains resulting from the engagement of the stock and tools is afforded.

The pins are automatically withdrawn from engagement with the turret to permit the latter to rotate at the proper time by arms e^5 e^6, projecting laterally from a rock-shaft e^7, mounted in the carriage, as shown in Figs. 51, 64, and 68. This shaft has an arm e^8 projecting laterally therefrom, on the end of which there is a cam e^9, which when the dogs are in engagement with the turret is in the path of a cam e^{10}, pivoted in the end of the rack d^{10}, whereby when the rack is held against movement by its engagement with the bar d^{13} and the carriage continues its movement away from the chuck and the work therein the cam e^9 is thrust downwardly to rock the shaft e^7 and lower the pins e' out of engagement with the turret to permit it to rotate.

The index-pins are not permitted to engage the turret until the next tool has been brought into operative position, and to accomplish this I secure to the shaft e^7 another arm e^{11}, which when the shaft e^7 is rocked downward slips under the head of a spring-held latch e^{12}, mounted on the carriage, as shown in Figs. 77 to 79, and holds the pins depressed.

As before stated, the turret has provisions for receiving eight different tools, but of course the lathe is used many times when there are but three or four tools used successively upon the work. Consequently it may be desirable at times to rotate the turret more than one-eighth of a rotation, and therefore the turret is provided with eight stops, each consisting of an adjustable screw e^{13}, any one of which may be driven down far enough to engage the top or head of the latch e^{12} and release the arm e^{11} to permit the index-pins to again engage the turret. If it is desired that the turret should be advanced one-eighth of a rotation for each reciprocation of the carriage, then all eight of the stops are screwed down into operative position, but if there are less than eight tools the stops corresponding to the tools employed are rendered operative and the others are partially unscrewed, so that they will not engage the latch e^{12}.

I employ fluid-pressure controlled by hand or automatically at will for effecting a forward-and-back movement of the carriage. By mechanism which I shall describe the carriage is advanced rapidly to bring the tool into position to engage the work and is then fed slowly forward at any desired rate of speed until its work is accomplished. Then an additional volume of fluid is utilized to rapidly return the carriage, whereby the time spent in withdrawing the carriage, rotating the turret, and bringing the next tool into operative position is very short.

Referring to Figs. 32 to 50, inclusive, and at first more particularly to Fig. 33, it will be seen that the carriage is formed with a fluid-cylinder f, extended longitudinally thereof and arranged on one side of the central longitudinal line of the machine. The end of the cylinder left open in the construction of the carriage is suitably closed by a cylinder-head f' and packing f^2. A stationary piston f^3 is centrally perforated and is rigidly connected to a comparatively small inlet-pipe f^4, through which fluid is admitted to the front side of the piston for the purpose of forcing the carriage forward or in the direction of the arrow 3 toward the work. A larger pipe f^5 is connected to the piston and is provided with ports f^6 in its inner end to admit fluid to the rear side of the piston to force the carriage in the direction of the arrow 4 away from the work. The pipes or tubes pass through the cylinder-head f' and are rigidly secured in the cross-bar d^{14} in the end of the bed a. The outer end of the tube f^5 is closed by a suitable head f^7, through which the tube f^4 projects, there being suitable packing, as indicated, surrounding the last-mentioned tube. Liquid is automatically admitted to the tube f^5 through a duct f^8, extending through the cross-bar d^{14}, as indicated in the last-mentioned figure. The tubes f^4 and f^5 are respectively connected with a valve-casing g by pipes f^9 f^{10}, (shown particularly in Figs. 45 to 49, inclusive,) and the valve g' is automatically operated to admit fluid first into one of the pipes and then into the other, as will be afterward explained. The valve-casing is supported on the end of the bed and the inlet in the valve-casing is connected with the force-pump cylinders h h, supported on the head-stock, by a pipe h', having the branches h^2 h^3, leading to the said pump-cylinders, the last-mentioned parts being clearly illustrated in Fig. 12. The pump-cylinders h h are on the ends of the arms h^4 h^4 of a bracket h^5, secured to the housing a^4 of the head-stock, as shown in Fig. 12, and the piston-rod h^6 is connected midway between its ends to a slide h^7, passing through guide slots or apertures h^8 h^8 in the ends of said arms h^4, as shown in Fig. 38. Passing through the bracket h^5 is a rock-shaft h^9, having on its end a crank-arm h^{10}. A link h^{11} is connected to the end of the crank-arm by a bolt h^{12} and to the slide h^7 by a bolt h^{13}, which likewise connects the slide to the piston-rod, so that when the shaft h^9 is rocked the piston h^6 is reciprocated to force fluid into the inlet-pipe h', before referred to, from a supply-pipe h^{100}, there being suitable valves, as shown in Fig. 40. To rock the said shaft, an arm h^{14}, is loosely secured thereto and is connected

by a pitman-rod h^{15} to a crank-pin h^{16} on a pinion h^{17}, intermeshing with the pinion a^{14} before referred to as being secured upon the end of the chuck-driving shaft a^{15}, which furnishes motor-power to the chuck-carrier. Consequently so long as the chuck is being rotated the arm h^{14} is oscillated. The hub of the said arm is formed with ratchet-teeth h^{18}, and upon the crank-arm h^{10}, which is laterally extended, as shown in Figs. 40 to 42, are pivoted two inwardly-extending pawls h^{19} h^{20}, which operate to connect the crank-arm to the arm h^{14}, whereby when the arm h^{14} is oscillated the crank-arm is caused to move with it. By swinging the arm h^{10} to one side or the other relatively to the arm h^{14} the pivot-stud h^{11} may be swung to one side or the other, so as to vary the length of movement of the piston, and thereby increase or decrease the volume of fluid delivered by the pump to the inlet-ducts and vary the rate of speed at which the carriage travels forward during the time that the tool in the turret is operating. The arm h^{14} has always the same arc of movement, and consequently the arm h^{10} must have the same; but by changing the position of the said arm h^{10} to cause it to move in a path across the path of movement of the piston the movement of the latter will be greatly decreased in length, as will be readily apparent, and hence to effect a movement of one of the arms relatively to the other and to accomplish this automatically I provide the following devices:

Loose upon the rock-shaft h^9 is a partial gear h^{21}, provided with a V-shaped recess formed by two inclined walls h^{22} h^{23}. The pawls h^{19} h^{20} are provided with outwardly-projecting pins h^{241}, which extend into the recess in the partial gear. When it is desired to adjust the relations of the two arms h^{10} h^{14}, the partial gear is rotated slightly to one side or the other and one of the pawls h^{19} or h^{20} is lifted out of engagement with the ratchet-toothed hub h^{18} of the arm h^{14}, whereby only one-half of each reciprocation of the arm h^{14} is effective until the crank-arm is moved relatively thereto by the operative pawl, so that both pawls h^{19} h^{20} are in engagement with the toothed hub. The partial gear is operated automatically by mechanism under the control of the turret, which I subsequently describe, through the medium of a rack h^{24}, connected to a chain h^{25}, both passing through the end of the bed, as shown in Fig. 34. A spring h^{26} surrounds the end of the rod h^{25} and abuts at one end against a collar thereon and at the other end against the bed. The volume of fluid from the pumps, which is varied to suit the character of the work being done by the tool, passes into the valve-casing and is deflected into either of the two feeding-ports f^9 f^{10} to move the carriage in one direction or the other. The pump which is thus interposed between the source of fluid-supply and the valve mechanism operates as a measuring device to supply a predetermined volume of fluid to the cylinder, and it is actuated simultaneously with the work-holder by the devices previously described. Each movement of the piston measures off a predetermined volume of fluid, which is fed into the cylinder.

Referring more particularly to Figs. 45 to 49, inclusive, a valve g' is shown, which is adapted to permit the entrance of fluid from the pipe h' into the pipes f^9 f^{10} alternately, there being an outlet or escape duct h^{261} communicating with a discharge-pipe h^{27} and the ducts being so arranged that when fluid is flowing through the pipe h' into the cylinder on the front side of the piston the liquid on the rear side of the piston is being discharged through the pipe h^{27}, (see Fig. 46,) and when fluid is entering the rear side of the piston f^3 through the pipe f^{10} the fluid on the front side of the piston is escaping through the tube f^9 into the said outlet, as shown in Fig. 46. I have not deemed it necessary to describe in detail the exact construction of the valve-casing nor the location of the ports therein, as the details of construction in this feature of my lathe are not necessarily essential, and I may employ any suitable valve mechanism in place of the one shown. The valve is provided with a stem g^2, which is reduced at its end, as at g^3. A collar g^4 is placed upon the said end, and between it and the shoulder g^5 on the valve-stem a spiral spring g^6 is placed, so that when the centrally-pivoted lever g^7 is swung about its fulcrum to oscillate the valve to the left in Fig. 45 the latter is moved with a yielding pressure. The lever g^7 has on its upper end a pin g^8, taking into the slot g^9 in the end of an arm g^{10}, keyed to the projecting end of the shaft i, as shown in Figs. 53 and 54. This shaft is mounted upon the turret-carriage to travel therewith, and it extends through the cross-bar d^{14} on the bed, and inasmuch as it must slide through the arm g^{10} the latter is pinned to a sleeve g^{11}, feathered on the shaft and mounted rotatably in a bracket g^{12}, as shown in Fig. 54. The inner end of the sleeve g^{11} is flanged and lies between the bracket and the cross-bar d^{14}, on which the said bracket is mounted, whereby the shaft is free to slide through the sleeve without effecting a longitudinal movement thereof, although when the said shaft i is rocked it effects a movement in or out of the valve g'. The rocking movement of the said shaft i is effected automatically by the carriage, as I shall now proceed to explain, there being means corresponding to each tool on the turret for stopping the forward movement of the carriage by shifting the valve.

Referring again to Figs. 60 to 69, it will be seen that the shaft i is in alinement with the rock-shaft e^7, hereinbefore described, and that it is provided with a laterally-projecting arm i' close beside the arm e^6 on the shaft e^7. The arm e^6 is provided with a stud i^2, which projects over the arm i' and limits the upper movement thereof, there being in the car-

riage a spring-held pin i^3, which engages the arm i' when it is depressed, as shown in Fig. 70, and prevents the upward movement thereof unless positively actuated. There is likewise a spring-pressed pin i^4, mounted in a thimble i^5 in the arm e^6, which normally projects into the socket i^6 in the arm i', so as to connect the two arms together. The end of the arm i' is slotted, as at i^7, to permit the end of the pin i^4 to be engaged and thrust backward out of the socket. Mounted in the bed are a plurality of stop-rods i^8, one for each tool or groove of the turret, and each having its inner end i^9 (see Fig. 62) recessed to form a stop, and mounted immediately above the said rods on the carriage are a plurality of movable pawls or stops i^{10}, so that if any one of the latter were allowed to drop down to the position shown in Fig. 62 it would engage the stop-rod immediately thereunder. Each of the movable stops or pawls i^{10} is connected by a ball-and-socket joint with a lever i^{11}, all of the said levers being fulcrumed upon a cross-bar i^{12}, supported in the carriage and having grooved rollers. The tappet-rods i^{13}, one for each lever i^{11} and pawl i^{10}, are mounted in the carriage, and their ends project under the upper portion of the turret c. They are arranged to engage depressions or sockets i^{14}, Figs. 5 and 61, in the under surface of the top portion of the turret, there being a special socket for each of the tappet-rods i^{13}. When the turret is at a state of rest on the carriage and the latter is being advanced, one of the sockets i^{14} is immediately over one of the tappet-rods i^{13}, whereby its stop or pawl i^{10} is allowed to drop into the notch in the stop-rod immediately thereunder when the carriage reaches the desired end of its forward movement.

The movable stops i^{10} are all pivoted upon a shaft i^{15}, having its ends journaled in a frame i^{16}, extending between arms i^{17} of the bracket i^{18}, in which the cross-bar i^{12} is mounted. (See Figs. 56 and 57.) The frame i^{16} is pivoted in the said arm i^{17} immediately above the shaft i^{15}, and it is provided with an arm i^{19}, which when the frame i^{16} is rocked is depressed, as shown in Fig. 62. The end of the arm i^{19} projects over the end of the arm i' just above the slot i^7 therein, and rests lightly upon the end of the spring-pin i^4. Consequently when one of the movable pawls drops so as to engage the notch in the end i^9 of one of the stop-bars at the time when the carriage has reached the desired end of its movement toward the chuck or has moved forward a predetermined distance its engagement with the said end swings the frame i^{16} backward to move downward the forward end of the arm i^{19}, and thereby forces the spring-pin i^4 out of the socket i^6, depresses the end of the arm i' far enough to rock the shaft i, and shifts the valve to permit the flow of fluid from the pump to the rear side of the piston. Therefore by adjusting the stop-bars i^8 the carriage may be fed toward the work a predetermined distance from each tool, and when the movable stop engages the stop-bar the downward movement of the arm i^{19} forces downward the arm i' and rocks the rock-shaft i to shift the valve g' and cut off the flow of liquid to the pipes f^9 and f^3.

The arm i' is held downward by the engagement of the spring-pin i^3 therewith until when the carriage approaches the end of its movement away from the work the rock-shaft e^7 is rocked by the device previously described, whereupon the spring-pressed pin i^4 enters the socket i^6, and as the index-pins slip into their bushings in the turret the arm i' is raised and the rock-shaft again rocked to throw the valve in the opposite direction and deflect the flow of fluid into the pipe f^{10} and cause the carriage to be fed forward.

For causing the initial rapid movement of the carriage to bring the tool into position to engage the work and to bring it away from the work I employ an auxiliary pump, which is indicated conventionally upon the drawings in Fig. 45 and which may be driven from an independent source of power or from the motor of the lathe. The supply-pipe j' from the said pump j enters the valve-casing g at the left end thereof, as shown in Figs. 45 to 48, inclusive, and to deflect the fluid therefrom to the inlet-duct g^{211} or to the outlet-duct h^{26} there is a valve j^2, which is movable independently of the valve g'. The bushing j^{13}, in which the valves g' and j^2 operate, is provided with a partition j^{14}, which is apertured at j^5, into which aperture a small piston j^6 on the end of the valve g' may enter to engage the projection j^7 on the end of the valve j^2. Leading from the chambers on both sides of the partition j^{14} are vents j^8 j^9, and it is thus seen that the chambers provide, as it were, a dash-pot resistance to the movement of the valves g' and j^2—that is to say, when either piston closes the aperture j^5 the chamber is temporarily closed too, for the fluid therein escapes slowly, and consequently the movement of the piston and the valve is checked. The movement of the valve g' in one direction to permit the fluid to pass from the auxiliary pump into the inlet g^{211} is effected by the inward movement of the valve j^2 after it has overcome the dash-pot resistance. As the piston j^6 passes through the aperture j^5 in the partition j^4 and engages the projection j^7 on the valve j^2 it forces the valve over far enough to register with the port j^{11} and the inlet-port j^{12}, and the valve will remain in this position until thrust automatically in the opposite direction by mechanism to be described. Consequently when the carriage is being fed forward during the time when the tool is operating on the work and until the movable stop reaches its abutting notch the additional volume of fluid is cut off from the front side of the piston; but when the carriage reaches the end of its predetermined movement the valve g' is moved by yielding pressure to permit the entrance of the fluid in additional volume to

the rear side of the piston. The yielding pressure of the valve is made by the dash-pot resistance, which permits the turret to move forward to the end of its stroke long enough for the tool to nicely smooth up the shoulder on the work to which it is traveling. As the resistance of the dash-pot decreases by the escape of the cushioning substance through the vent the valve goes over the full distance and besides opening the port to the pipe f^{10} also engages the valve j^2 and forces it into position to permit the quick feeding volume of fluid to pass from the auxiliary pump into the inlet g^{211} and thence into the rear side of the piston to effect the return of the turret-carriage. The auxiliary pump continues to force fluid into the inlet g^{211} until upon the forward movement of the carriage the valve g' is thrust in the opposite direction by the bell-crank lever j^{131}, which is pivoted at j^{141} in the end of the valve-casing. The bell-crank lever j^{131} is connected by a link j^{15} with a centrally-pivoted lever j^{16}, having a yielding latch j^{17}, with which is adapted to coact any one of a series of stops on a rotating stop-carrier movable in unison with the turret.

The turret, as shown in Fig. 10, is provided with a bevel-toothed ring k in its under surface, which intermeshes with and drives a bevel-gear k' on a shaft k^2, projecting through the side of the carriage. On its end this shaft has a spiral gear k^3, intermeshing with, and a driving-spiral gear k^4, on an inclined shaft k^5, journaled in a bracket carried by the carriage. Spiral gears k^6 k^7 impart power from the shaft k^5 to a longitudinally-grooved shaft k^8, mounted in bearings k^9, supported by the carriage and bracket s^{13} on the bed. Upon this shaft k^8 is a grooved stop-carrier k^{10}, in which there may be placed as many stops k^{11} as there are tools, and the stops are adjustable, so that they may be brought to engage the latch end j^{17} on the end of the lever j^{16} at that point in the movement of the carriage toward the chuck when the tool is about to begin its work. Consequently if the carriage is to be advanced half its movement before the tool engages the work the stop is arranged not to engage the latch j^{17} until the carrier reaches that point. In other words, the stops k^{11} are adjustable with relation to each other just as are the stop-rods i^8 on the bed, so that as soon as the tool with which a stop corresponds is about to begin its work the valve j^2 is operated. The stops k^{11} are brought successively into alinement with the latch-lever j^{16} as the turret is rotated, and the latch is arranged to be operated by the forward movement of the carriage and to yield when the carriage is moving in the opposite direction.

From the mechanism which I have thus far described it will be seen that the carriage will be fed toward the work rapidly until the tool is ready to engage the work, when one of the stops k^{11} will engage the lever j^{16} and operate the valve j^2 to cut off the fast-feeding volume of fluid. Then the carriage will be fed slowly forward as the tool performs its allotted work. As the tool finishes its work the carriage is automatically stopped in its forward movement and is carried rapidly away from the work, and in its return movement the turret is rotated; but it is not until the index-pins have entered their bushings in the turret that the valve g' is operated to turn the fluid into the ports, which cause the feeding of the turret toward the work.

The auxiliary means for accelerating the movement of the carriage is thrown into or out of operation at any desired time, being under the control of two sets of stops, of which one set on the bed causes it to be thrown into operation when the tool finishes its work and the other on the rotating stop-carrier causes it to be thrown out of operation after the turret has been rotated, the carriage has been advanced, and the next tool is about to begin its work, and, too, the controlling mechanisms are directly governed by the movement of the turret, whereby the auxiliary means is thrown into or out of operation in accordance with the time it takes each tool to perform its allotted duty or the relative positions of the stock and the tool.

I shall now proceed to describe the motor for rotating the chuck-carrier and the mechanism by means of which the chuck may be kept at a constant desired speed, irrespective of the resistance of the tool on the work.

The motor consists of a wheel m, as shown in Figs. 15 and 16. It is provided with a series of sets of concentric blades m', the blades being curved and at an inclination to the face of the wheel, as shown in Fig. 16. The wheel itself is rigidly secured to a shaft m^2, which projects through the casing m^3, in which the water-wheel m is confined, into the housing a^{17} of the lathe, being journaled in the bracket a^{16} before referred to. Two nozzles m^4 m^5 are employed, one for directing a stream of liquid against the concave sides of the blades to propel the wheel in one direction and the other being arranged to direct the water against the convex sides of the blades to propel the wheel in the opposite direction. The nozzles are swiveled in the casing, so as to swing radially of the water-wheel, whereby the stream of fluid may be directed against any one of the series of pockets for furnishing a differential movement to the said wheel—that is to say, the nozzles are provided with the stud m^6, journaled in one side of the casing, and the pipe m^7, journaled in the other side and registering with the pipe from which the liquid is supplied. There is a valve m^8 at the junction of the nozzles, which is operated by a lever m^9 to turn the water into either of the two nozzles, the last-mentioned lever being itself operated by a link m^{10}, connected to a hand-lever m^{11}, fulcrumed to the bed in a position easy of access to the operative. The lever m^9 is pivoted to the stem of the valve, so that the parts are not caused to bind when the nozzles are swung upon their

center of movement. The stud m^6 is connected to a shaft m^{13}, which is journaled in one of the supports of the bed and is provided with a laterally-extended arm m^{14}, by which it is rocked to vary the position of the nozzles. By a mechanism which I shall now describe and which is controlled by the turret the shaft m^{13} is rocked automatically to adjust the nozzles m^4 m^5, and thereby vary the power transmitted by the motor to the chuck-carrier.

A shaft k^8, which I have previously described as being rotated in unison with the turret and as moving with the carriage, passes through the hub of a gear n, journaled in bushings n' in the bed, Fig. 28, and splined to the shaft so as to turn therewith and permit longitudinal movement of said shaft therethrough. The gear intermeshes with and drives a toothed stop-carrier n^2, journaled loosely upon a stud-shaft n^3, projecting forward from a bracket n^4, secured to the side of the bed. This stop-carrier is provided with a series of axially-arranged pins or stops n^5 equidistant from each other and each held adjustably in place by a set-screw n^6. There are eight of these stops and they are brought one by one into operative position each time the turret is rotated, provided eight tools are employed. The bracket n^4 before referred to is formed in two parts, one secured upon the other, as shown in Fig. 13. A shaft n^7, having one end journaled in a standard n^8 arising from the motor-casing, is journaled at its other end in a block n^9, secured in the said bracket, (see Fig. 28,) and it is formed with a worm or screw-threaded portion n^{10}, which rotates in a chamber or socket in the bracket. On the inner side of the shaft n^7 the bracket is provided with a way n^{11} to receive a slide n^{12}, which is placed therein, and in which is transversely mounted a sliding hollow pawl or nut section n^{14}, having its end threaded to register with the threads on the shaft n^7, but normally disengaged therefrom. This slide n^{12} is provided with a screw-stud n^{15}, which projects laterally through a slot n^{161} in the side of the bracket and is connected by a chain or rope or other flexible connection n^{16}, which passes over a pulley n^{17}, journaled on a stud extended out from the bracket with the arm m^{14} before referred to, there being a weight m^{15} attached to the said arm. The slotted end of the slide n^{12} is hollow to receive the end of the lever n^{18}, which is pivoted at its center therein, and one end of which extends into an aperture in the hollow nut-section. A screw n^{19} is passed through the outer end of the nut-section and bears against the end of the lever, there being a spring n^{20} on the other side of the said end of the lever, so that when the lever is swung about its pivot the nut-section is forced yieldingly into engagement with the screw n^{10}. A spring n^{21}, placed in a socket in the lever n^{18}, tends to normally hold the nut-section out of engagement with the worm on the threads on the shaft n^7. Now it will be seen that by adjusting the stops n^5 to the desired position each time the stop-carrier is rotated one of them will be brought into engagement with the end of the lever n^{18}, and thereby force the nut-section into engagement with the worm n^{10}, whereby the rotation of the shaft n^7 is accomplished by means of a belt o passing around a belt-wheel o' thereon and around a similar wheel on the shaft m^2, causing the slide to be moved in the direction of the arrow in Fig. 28 against the stress of the weight until the outer end of the lever slips off the end of the stop, whereupon the nut-section is immediately drawn out from engagement with the worm. The slide n^{12} is prevented from returning under the pull of the weight at the end of a chain by the stop n^5 engaging the end of the lever. When the turret is again turned, however, and the stop-carrier is rotated, immediately upon the stop leaving the end of the lever, the slide n^{12} returns to its original position before the next stop n^5 engages it. Thus it will be seen that the position of the nozzle is easily controlled by varying the length of the stops n^5.

The mechanism as above described may be said to be automatically actuated or operated to deliver a variable volume of fluid to the fluid-operated carriage-feeding means in accordance with the character of the work done by the operating-tools, and in addition to being turret-controlled is likewise governed by adjustable stops on the stop carrier or controller.

On the outer side of the shaft n^7 I mount a similar slide p, equipped with a nut-section p' and lever p^2, similar to those just described. This slide p is connected with the chain h^{25}, before referred to, which controls the action of the pump, said chain being connected thereto by the threaded stud p^3 and passing around an idler p^4, mounted upon the lower end of the arm p^6, depending from a bracket p^7, attached to the head-stock. The lever p^2 is engaged by stops p^8, adjustably mounted on the stop-carrier n^2. The means for securing the stops in place consist of two clamping members p^9, one of which is screwed into the carrier, and a screw p^{10}.

From the description just given it will be seen that the motor and the pump are both automatically controlled by controllers coacting with or actuated by the turret, so that the speed at which the carriage is moved, as well as the speed of rotation of the chuck, is automatically regulated, and hence after the machine has been once adjusted each tool will be advanced at the proper rate of speed and the chuck will be driven in accordance with the work to be done by the said tool. It will be observed that the two slides n^{12} and p are equidistant, and consequently it results that the levers n^{18} p^2 are also equidistant from the shaft n^7, and hence the stud-shaft n^3 is mounted to one side of the axis of the shaft n^7, so as to provide two concentric circles of stops

n^5 p^8 on the stop-carrier n^2, which are eccentric with reference to the shaft n^7, whereby the said stops may properly engage the levers.

Although I have described the motor and the chuck, yet I have not described the gearing for transmitting power from the motor-shaft m^2 to the chuck-driving shaft a^{15}, and shall now proceed to do so. I provide the mechanism shown in Figs. 16 and 21 to 28, inclusive. Rigidly secured to the shaft m^2 are two gears r r' of different diameters, and meshing therewith are two gears r^2 r^3, mounted loosely upon the chuck-driving shaft a^{15}, a sliding sleeve r^4 between the said gears r^2 r^3 being adapted to cause the clutching of either of them to the shaft. The mechanism interposed between the said sleeve and the said gears is of any suitable type, one form being shown in the patent to W. A. Leonard, No. 551,213, dated December 10, 1895. To slide this sleeve, I employ a centrally-pivoted lever r^5, the upper end of which has a projection extending into a groove therein and the lower end of which has a similar projection extending into the groove in a sleeve r^6, sliding loosely upon the motor-shaft m^2. This sleeve has a circumferential flange r^7, which is extended laterally at its rim to form a diamond-shaped cam r^8. Four plungers s s' s^2 s^3 are mounted in the bracket s^4, supported upon the housing a^{17}, and are each adapted to be thrust forward to engage the cam r^8 by a spring s^5, as shown in Figs. 21 and 22, said spring being mounted in a socket therein. If when the parts are in the position shown in Fig. 16 the plunger s be allowed to move forward to engage the cam r^8 as the cam revolves, the sleeve r^6 will be forced thereby, so as to unclutch the gear r^3 from the shaft a^{15}, while the plunger s' would have to be projected against the sleeve r^6 to move it far enough to effect the clutching of the gear r^2 to the shaft a^{15}. The plungers s^2 s^3 effect similar movements of the sleeve r^6 in the opposite direction. The plungers are held in their inoperative positions by pawls s^9 engaging shoulders s^{10} thereon, said bolts being connected by links or trackers s^{11} with centrally-pivoted levers s^{12}, the pivot on which the said levers are mounted extending out to the end of the bracket s^{13}. In this last-mentioned bracket is placed a bushing s^{14}, in which is rotatably mounted a stop-carrier t, (see Fig. 28,) through which the grooved shaft k^8 passes and to which it is keyed. The stop-carrier is in the form of a cylinder, and it is reduced to receive the bushing s^{14}, whereby it is held against longitudinal movement as the shaft k^8 slides therethrough. It is longitudinally grooved, there being as many grooves as there are stops n^5 or p^8, and the stops t' may be secured in the said grooves in position to engage any one of the said levers s^{12}. Therefore as the turret is rotated any one of the plungers may be released to effect a movement of the sleeve r^6, thus throwing either clutch into operation, according to the speed required, or else bring it to a state of rest. To return the plungers to their normal position, the flange r^7 is provided with another cam r^{14}, which is wide enough to engage the ends of the plungers and force them back into the position shown in Fig. 23.

From the foregoing it will be observed by any one skilled in the art to which this invention relates that I have provided a machine which may be, if desired, entirely self-controlled or self-acting and which will perform in order a series of operations upon a piece of stock, rotating the chuck and the stock and advancing the carrier at a rate of speed desirable for the tool operating on the stock, whereby the presence of an attendant or operator, save for the purpose of securing the work in the chuck, is practically unnecessary.

Regarded as a whole the lathe possesses many features of advantage over others heretofore used, not only by reason of its being automatic, but by reason of its being able to more accurately finish the work if a nicety of operation is a requisite or else to "rough out" or "chuck out" work to be finished in another machine. The peculiar form of chuck-carrier adds greatly to the accuracy of the lathe, which is also insured by the turret and the mechanism which secures it in place. The chuck-carrier being journaled at or near its center, as well as near its outer edges, is held against the slightest movement save that of rotation, and consequently the work is rotated relatively to the cutter or other tool with accuracy and precision, and the turret is similarly guarded from movement under angular strain, for it is not only journaled at the center, but it is gibbed to the carriage at its outer edge. The construction of the turret and the carriage by which the gibs and the parts within the turret and carriage are housed and guarded from an accumulation of dust and cuttings prevents the delicate and operative parts from being injured and insures an even and easy movement of the turret. The turret after being rotated is centered with great accuracy by two index-pins instead of one and is rigidly locked in place thereby with the proper tool in position to operate upon the stock in the chuck.

The form of the bed and head-stock which I have shown and described possesses many obvious advantageous features, among which are its provisions for supporting the rotating chuck-carrier at its outer edges. The bed and head-stock are shown as formed in one casting; but it is evident that they may be cast in any desired number of pieces.

It is unnecessary to specifically mention the advantages accruing from the use of the automatic controller for the auxiliary liquid-supply, by means of which a rapid movement of the carriage is attained, nor to point out the beneficial results obtained by the employment of the automatic controller for regulating the movement of the pump-piston and

consequently the volume of fluid delivered from the pumps to the carriage-feeding cylinder, by means of which the working feed of the carriage is regulated in accordance with the character of the work being done by the operative tool, as they are apparent to those familiar with lathes of this class, it being sufficient to state that thereby no time is lost in withdrawing the carriage to turn the turret for the presentation of another tool and returning it to the stock and that the lathe is rendered entirely automatic, work of different kinds and character being performed by the cutters as perfectly as though the machine were under the constant control of the hand of the operator, and in addition to the movement of the turret-carriage being regulated to the character of the work the rotation of the chuck-carrier is changed or the carrier is held at a state of rest when the work is completed or to permit an inspection of the stock.

One thing to which I desire to call attention in connection with the feeding of the carriage is that by the mechanism which I employ the carriage is not started forward until the index-pins have fully entered their respective bushings in the turret, the movement of the valve which controls the passage of fluid into the feeding-cylinder being dependent upon and simultaneous with the movement of the said pins.

It will be observed that the movable stops on the bed with which the tappet-rods (controlled by the turret) coact to shift the valve and reverse the movement of the carriage are located under the carriage, so that they are covered and protected from cuttings at the extremes of movement of the carriage, this being accomplished by extending the carriage rearwardly and lengthening the rods which coact with the tappet-rods and which are supported upon the tilting frame and mounting the said frame in the said extended end of the carriage.

Another desirable feature of the lathe is that the controllers for the "back gear" or gearing for the chuck-carrier, the pump, the motor, and the quick-feeding mechanism are all actuated from a single shaft geared to the turret and coacting therewith, the controllers for the back gear and the valve which regulates the passage of fluid from the auxiliary pump to the feeding-cylinder being mounted directly upon the shaft itself.

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

1. A turret-lathe having a flat, square-topped turret with provisions for supporting operating-tools at or near the corners of its upper surface.

2. A turret-lathe having a polygonal flat-topped turret with provisions for receiving tools at or near the corners of its upper surface.

3. A turret-lathe comprising a chuck; and a flat-topped turret arranged to pass beneath the work, said turret having at least one edge substantially the width of the chuck and also having provisions for supporting tools on its upper surface along the said edge.

4. A turret-lathe having a flat square-topped turret, with intersecting diagonal and diametrical grooves in its top surface, to receive the operating-tools.

5. A turret-lathe having a flat-topped or plate-shaped turret adapted to pass beneath the work, said turret being square in plan, and having provisions for receiving tools on its upper surface along one or more edges.

6. A turret-lathe having a plate-shaped square turret, with grooves in its face extending diagonally between its corners and diametrically between its sides, to receive the operating-tools, and means for supporting the corners of the said turret.

7. A turret-lathe comprising a square plate-shaped turret with a depending cylindrical portion, a carriage having a cylindrical depression to receive the said portion, said turret extending over or overlapping the edges of the carriage, means for journaling the turret at its center in the carriage, and additional means for supporting the corners of said turret.

8. A turret-lathe comprising a plate-shaped turret with a depending cylindrical peripherally-grooved portion, a carriage having a cylindrical depression to receive said portion, and in which said turret is journaled and held against angular strains, means for centrally journaling said turret on said carriage, and gibs located below the surface of said carriage and entering the said groove in said cylindrical portion of the turret.

9. A turret-lathe comprising a turret having a flat top to receive the tools thereon, and a depending flanged ring, a carriage, a central bearing for journaling said turret on said carriage, said carriage having a socket to receive said ring and an annular flange for the outer edges of the top of the turret to rest upon, and means on the carriage taking over the ring to secure the turret to the carriage.

10. A turret-lathe comprising a plate-shaped turret having a depending boss with a peripheral groove, a carriage having an annular depression for receiving and affording lateral support for said grooved boss, and gibs taking into the groove to secure the turret rotatably to the carriage.

11. A turret-lathe comprising a plate-shaped turret having a depending boss with a peripheral flange, a carriage having an annular ring or flange to receive the boss and which is overlapped by the top of the turret, said flange being formed with sockets, and gibs arranged in said sockets and taking over the said peripheral flange.

12. A turret-lathe comprising a plate-shaped turret having a depending boss with a peripheral flange, a carriage having an annular ring or flange to receive the boss and which is over-

lapped by the top of the turret, said flange being formed with sockets, and removable pins arranged in said sockets and having heads or ends taking over the said flange to secure the turret rotatably in the carriage.

13. A turret-lathe comprising a plate-shaped turret having a depending boss with a peripheral flange, a carriage having an annular ring or flange to receive the boss and which is overlapped by the top of the turret, said flange being formed with sockets, removable pins in said sockets and taking over the said flange, and means for adjustably securing the pins in the carriage.

14. A turret-lathe comprising a carriage, a rotatable tool-holder or turret loosely pivoted thereon, and a plurality of index locking-pins adapted to center the said tool-holder and lock it against rotative movement, whereby the looseness of the pivotal connection is corrected.

15. A turret-lathe comprising a carriage having a bearing, a turret rotatably mounted on said bearing and having sockets, and a plurality of index-pins adapted to enter said sockets and to coact with the said bearing for holding the turret against rotative movement and horizontal thrusts.

16. A turret-lathe comprising a carriage, a turret rotatable thereon and having sockets, a plurality of index-pins on the carriage adapted to enter said sockets, and automatic devices for simultaneously operating said pins to lock or release the turret.

17. A turret-lathe comprising a carriage, a turret rotatable thereon, two separate index-pins adapted to lock or release the turret, and mechanism for automatically and simultaneously operating said index-pins, said mechanism including a rock-shaft having an arm for each pin.

18. A turret-lathe comprising a bed, a carriage slidable thereon, a turret rotatable on the carriage, two or more index-pins for locking the turret to the carriage, a rock-shaft mounted on the carriage and having an arm for each of said pins, and means for rocking said shaft and rotating the carriage.

19. A turret-lathe comprising a bed, a carriage, a rotary turret, two or more index-pins for locking the turret to the carriage, a pinion, pawls adapted to connect the pinion and the turret, a rack on said carriage adapted to rotate said pinion, and an abutment for said rack having latches to engage the end thereof, for the purpose set forth.

20. A turret-lathe comprising a bed, a carriage slidable thereon, a turret rotatable on the carriage, two or more index-pins for locking the turret to the carriage, a rock-shaft mounted on the carriage and having an arm for each of said pins, a pinion adapted to be connected to the turret when rotated in one direction, a rack adapted to mesh with said pinion and also adapted to engage said arm, and an abutment having spring-latches to engage the end of the said rack.

21. A turret-lathe comprising a bed, a carriage, a tool-holding device on the carriage, means for feeding and withdrawing said carriage, and additional means governed by the turret for accelerating the movement of the carriage-feeding means.

22. A turret-lathe comprising a bed, a carriage, a tool-holding device on the carriage, means for feeding and withdrawing said carriage, auxiliary means adapted to coact with said feeding means for accelerating the movement of said feeding means, and means for automatically disconnecting or cutting off said auxiliary means when the tool is performing its allotted duty.

23. A turret-lathe comprising a bed, a carriage, a tool-holding device on the carriage, means for feeding and withdrawing said carriage, auxiliary means adapted to coact with said feeding means for accelerating the movement of said feeding means, and means for automatically throwing said means into or out of operation.

24. A turret-lathe comprising a bed, a carriage, a tool-holding device on the carriage, means for feeding and withdrawing said carriage, auxiliary means for accelerating the movement of the carriage, and a series of adjustable stops, one for each tool, for controlling said means, whereby it may be thrown into operation at a predetermined time, or when a tool has finished its allotted duty.

25. A turret-lathe comprising a bed, a carriage, a tool-holding device on the carriage, means for feeding and withdrawing said carriage, auxiliary means including a separate source of power for accelerating the movement of the carriage, and a series of stops, one for each tool, for causing the said auxiliary means to be thrown out of operation when a tool is about to begin its work upon the stock.

26. A turret-lathe comprising a bed, a carriage, a tool-holding device on the carriage, means for feeding and withdrawing said carriage, auxiliary means for accelerating the movement of the carriage, and two series of adjustable stops, one for causing the auxiliary means to be thrown into operation, and the other for causing said means to be thrown out of operation.

27. A turret-lathe comprising a bed, a carriage, a rotatable turret, means for feeding and withdrawing the carriage, auxiliary means for accelerating the movement of the carriage, and mechanism governed by the rotation of the turret, for throwing said auxiliary means into or out of operation.

28. A turret-lathe comprising a bed, a carriage, a rotatable turret, means for feeding and withdrawing the carriage, auxiliary means for accelerating the movement of the carriage, a series of stops on the bed, a series

of pawls on the carriage controlled by the rotation of the turret and adapted to engage the stops, and connections between said pawls and said auxiliary means, for throwing the said means into action.

29. A turret-lathe comprising a bed, a carriage, a turret, fluid-operated means for feeding the carriage, a source of fluid-supply for furnishing fluid thereto, and an auxiliary source of fluid-supply for furnishing an additional volume of fluid to the said means, to accelerate the movement of the carriage.

30. A turret-lathe comprising a bed, a carriage, a turret, fluid-operated means for feeding the carriage, a source of fluid-supply for furnishing fluid thereto, an auxiliary source of fluid-supply for furnishing an additional volume of fluid to the said means, and a valve operated automatically to govern the supply of additional fluid from the said auxiliary source of supply.

31. A turret-lathe comprising a bed, a carriage, a turret, fluid-operated means for feeding the carriage, a source of fluid-supply for furnishing fluid thereto, an auxiliary source of fluid-supply for furnishing an additional volume of fluid to the said means, a valve, and mechanism for automatically operating the said valve to control the passage of the fluid from the said auxiliary source of supply.

32. A turret-lathe comprising a bed, a carriage, a turret, fluid-operated means for feeding the carriage, a source of fluid-supply for furnishing fluid thereto, an auxiliary source of fluid-supply, a valve, and turret-controlled mechanism for shifting said valve to govern the passage of fluid from the said auxiliary source of fluid-supply.

33. A turret-lathe comprising a bed, a carriage, a rotatable turret, fluid-operated means for feeding the carriage, a pump for supplying fluid to the said means, an auxiliary pump, a valve for the said auxiliary pump, and a series of turret-governed stops traveling with the carriage for shifting said valve.

34. A turret-lathe comprising a bed, a carriage, a rotatable turret, fluid-operated means for feeding the carriage, a pump for supplying fluid to the said means, an auxiliary pump, a valve for the said auxiliary pump, a series of turret-governed devices, and connections between said devices and said valve, whereby said valve is automatically shifted to permit the passage of an additional volume of fluid to the carriage-feeding means.

35. A turret-lathe comprising a bed, a carriage, a turret, means for feeding the carriage, means for accelerating the movement of the carriage, a stop-carrier rotating with the turret and having a stop for each tool, devices controlled by said stops for throwing said accelerating means out of action, and means actuated by the turret for throwing said accelerating means into action.

36. A turret-lathe comprising a bed, a carriage adapted to sustain a tool-holder, and means for feeding the carriage forward a series of times, and each time for a different predetermined distance, said means being arranged and controlled by the turret to automatically return the carriage.

37. A turret-lathe comprising a bed, a carriage, a turret on said carriage adapted to sustain a plurality of tools, and means controlled by the turret for automatically feeding the carriage a distance proper for each tool and then returning it, whereby said carriage may be advanced a greater or less distance for each succeeding tool and withdrawn to its original starting-point.

38. A turret-lathe comprising a bed, a carriage, a rotary turret adapted to sustain a plurality of tools, means controlled by the turret for advancing and withdrawing said carriage automatically, and a stop adapted to arrest the forward movement of the carriage at a predetermined point.

39. A turret-lathe comprising a bed, a carriage, a rotary turret adapted to sustain a plurality of tools, means controlled by the turret for automatically advancing and withdrawing the carriage, and a series of turret-controlled devices, one for each tool, adapted to arrest the forward movement of said carriage.

40. A turret-lathe comprising a bed, a carriage, a turret, a series of stops on the bed, a series of pawls on the carriage to engage therewith, a series of turret-controlled tappet-rods, intermediately-fulcrumed levers extending between said rods and said pawls, and feeding mechanism for the carriage controlled by said pawls.

41. A turret-lathe comprising a bed, a carriage, a turret having provisions for supporting a plurality of tools, mechanism for feeding the carriage, a rock-shaft for controlling the said mechanism, a series of stops on the bed equal in number to the tools, a series of pawls adapted to engage the stops, intermediately-fulcrumed levers connected to said pawls, tappet-rods connected to said levers and allowed to operate one at a time by said turret to cause a pawl to engage a stop, and connections between the pawls and the rock-shaft.

42. A turret-lathe comprising a bed, a carriage, a turret having provisions for receiving a plurality of tools, mechanism for feeding the carriage, a rock-shaft for controlling the said mechanism, a series of stops on the bed, equal in number to the tools, a series of pawls adapted to engage the stops, levers connected to said pawls, tappet-rods connected to said levers and allowed to operate, one at a time, by the turret, to cause a pawl to engage a stop, a frame for said pawls pivoted on the carriage, and an arm extending from said frame and connected to the rock-shaft.

43. A turret-lathe comprising a bed, a carriage, a turret, means for locking the turret against rotation, carriage-feeding mechanism, automatic devices for controlling the said

carriage-feeding mechanism, and connections between the said locking means and the said controlling mechanism, whereby the movement of the carriage in one direction is governed by the said turret-locking means.

44. A turret-lathe comprising a bed, a carriage, a turret, index-pins for holding said turret from rotating, means for automatically operating said pins, means for feeding the carriage, a controller for said feeding means, devices on the carriage for shifting the controller to feed the carriage in one direction, and connections between the said index-pin-operating means and the controller, to shift the latter to feed the carriage in the opposite direction.

45. A lathe comprising a bed, a carriage adapted to sustain a tool-holder, fluid-operated means for advancing and withdrawing said carriage, and a valve controlled automatically by the tool-holder for governing the movement of the carriage.

46. A turret-lathe comprising a bed, a carriage, a turret on said carriage adapted to sustain a plurality of tools, fluid-operated means for advancing and withdrawing said carriage, a valve, and mechanism governed by the turret for automatically controlling said valve to permit the carriage to be advanced different distances for the different tools.

47. A turret-lathe comprising a bed, a carriage, a turret on said carriage adapted to sustain a plurality of tools, a fluid-cylinder and piston, one connected to the bed and the other to the carriage, a valve governing the supply of liquid to different sides of the piston, and means governed by the turret for automatically shifting the valve to effect an advance and withdrawal of the carriage.

48. A turret-lathe comprising a bed, a carriage, a turret on said carriage adapted to sustain a plurality of tools, fluid-operated means for advancing and withdrawing the carriage, a valve-casing, a constant source of fluid-supply communicating with said casing, an auxiliary source of fluid-supply communicating with said casing, two valves, and automatic mechanism for controlling the two valves.

49. A turret-lathe comprising a bed, a carriage, a turret on said carriage adapted to sustain a plurality of tools, fluid-operated means for advancing and withdrawing the carriage, a valve-casing, a constant source of fluid-supply communicating with said casing, an auxiliary source of fluid-supply communicating with said casing, two valves in said casing, automatic mechanism for actuating one of the valves to advance and withdraw the carriage, and automatic mechanism for actuating the other of said valves to cut off the auxiliary source of supply.

50. A turret-lathe comprising a bed, a carriage, a turret on said carriage adapted to sustain a plurality of tools, fluid-operated means for advancing and withdrawing the carriage, a valve-casing, a constant source of fluid-supply communicating with said casing, an auxiliary source of fluid-supply communicating with said casing, an automatically-operated valve in said casing for governing the passage of fluid from the constant source of supply to the carriage-feeding means, and an automatically-operated valve for governing the passage of fluid from the auxiliary source of supply into the said casing, the last said valve being operated in one direction by the first said valve.

51. A lathe comprising a bed, a carriage adapted to sustain a tool-holder, a fluid-cylinder connected to and traveling with the carriage, a stationary piston, a stationary tube leading from the valve-casing through the piston to one side thereof, and a second tube leading to the other side thereof.

52. A lathe comprising a bed, a carriage adapted to sustain a tool-holder, a fluid-cylinder connected to and traveling with the carriage, a stationary piston, and two concentric tubes extending from the casing through the end of the cylinder and leading into opposite sides of the piston.

53. A lathe comprising a bed, a carriage adapted to sustain a tool-holder, a fluid-cylinder connected to and traveling with the carriage, a stationary piston, a hollow piston-rod forming a duct from the casing to one side of the piston, and a tube surrounding the piston-rod and forming a duct to the other side of the piston, said tube and rod extending through the cylinder-head and being supported by the bed.

54. A lathe comprising a bed, a carriage adapted to sustain a tool-holder, fluid-operated means for advancing and withdrawing the carriage, a valve for controlling the passage of fluid to the said means, and means for cushioning the carriage at each extreme of its movement.

55. A lathe comprising a bed, a carriage adapted to sustain a tool-holder, fluid-operated means for advancing and withdrawing the carriage, a valve for controlling the passage of fluid to the said means, and a valve-casing in which said valve operates, said valve having a compression or cushioning chamber.

56. A turret-lathe comprising a bed, a carriage, a rotary turret, fluid-operated means for feeding the carriage, valve mechanism for said means, and mechanism for automatically delivering a variable volume of fluid to the said valve mechanism in accordance with the work performed by the several operating-tools.

57. A turret-lathe comprising a bed, a carriage, a rotary turret, fluid-operated means for feeding the carriage, valve mechanism for said means, and mechanism controlled by the turret for automatically delivering a variable volume of fluid to the said valve mechanism.

58. A lathe comprising a bed, a work-holder, a slide movable on said bed, fluid-operated means for moving said slide, a measuring de-

vice inserted between the source of fluid-supply and said means, said device including a piston for admitting charges of fluid to said fluid-operated means, and mechanism for actuating the work-holder and causing the intermittent actuation of the said piston.

59. A lathe comprising a bed, a rotary work-holder, a tool-slide on said bed, fluid-operated means for moving said slide, a measuring device interposed between the source of fluid-supply and the fluid-operated means, and mechanism for actuating the work-holder and the measuring device simultaneously, whereby the rapidity of movement of the slide and the speed of rotation of the work-holder are directly related.

60. A turret-lathe comprising a bed, a carriage, a rotary turret, fluid-operated means for feeding the carriage, valve mechanism for said carriage-feeding means, and mechanism controlled by the turret and also governed by a series of adjustable stops for automatically delivering a variable volume of fluid to the said valve mechanism.

61. A turret-lathe comprising a bed, a carriage, a rotary turret, fluid-operated means for feeding the carriage, valve mechanism for said carriage-feeding means, and mechanism including a pump and a pump-controller, for delivering a variable volume of fluid to the said valve mechanism.

62. A turret-lathe comprising a bed, a carriage, a rotary turret, fluid-operated means for feeding the carriage, valve mechanism for said carriage-feeding means, and means including a pump and an automatic pump-controller, for delivering a variable volume of fluid to the said valve mechanism.

63. A turret-lathe comprising a bed, a chuck, power devices for rotating said chuck, a carriage, a rotary turret, fluid-operated means for feeding the carriage, and mechanism for delivering a variable volume of fluid to the said means, said mechanism including a pump actuated by said power devices, and devices for imparting a differential movement to the pump-piston.

64. A lathe comprising a bed, a carriage, a cylinder and piston for moving the carriage, a valve controlling the passage of fluid to said cylinder, and means for regulating the volume of fluid delivered to said valve.

65. A lathe comprising a bed, a chuck, power devices for rotating said chuck, a carriage, a cylinder and piston for moving said carriage, a pump actuated by said power devices for delivering fluid to said cylinder, and means for governing the stroke of the pump-piston.

66. A lathe comprising a bed, a carriage, a piston and cylinder for advancing and withdrawing the carriage, means for supplying fluid to said cylinder, valve mechanism between said means and said cylinder, and mechanism for controlling the volume of fluid received by said valve mechanism.

67. A turret-lathe comprising a bed, a carriage, a rotary turret, fluid-operated means for feeding the carriage, and mechanism for delivering a variable volume of fluid to the said means, said mechanism including a pump and devices controlled by the turret for automatically varying the length of stroke of the pump-piston.

68. A turret-lathe comprising a bed, a carriage, a rotary turret, fluid-operated means for feeding the carriage, and mechanism for delivering a variable volume of fluid to the said means, said mechanism including a pump, a rotary controller geared to the turret, and mechanism governed by said controller for varying the length of stroke of the pump-piston.

69. A turret-lathe comprising a bed, a carriage, a rotary turret, fluid-operated means for feeding the carriage, and mechanism for automatically delivering a variable volume of fluid to the said means, said mechanism including an automatically-actuated pump, a rotary stop-carrier geared to the turret and having an adjustable stop for each tool on the turret, and mechanism regulated by the position of the stops on the said carrier for varying the stroke of the pump-piston.

70. A turret-lathe comprising a bed, a carriage, a rotary turret, fluid-operated means for feeding the carriage, and mechanism for automatically delivering a variable volume of fluid to the said means, said mechanism including a pump, a controller for said pump, a shaft for said controller geared to the turret, a series of adjustable stops, one for each tool on the turret, a slide governed by the said stops, a device for varying the volume of fluid delivered by said supply, and connections between said device and said slide.

71. A turret-lathe comprising a bed, a carriage, a turret, a chuck-carrier, automatic mechanism for imparting a differential movement to the carriage, and automatic mechanism for imparting a corresponding differential rotation to the chuck-carrier.

72. A turret-lathe comprising a bed, a chuck, power devices for rotating said chuck at different predetermined speeds, a carriage, means for moving said carriage at different speeds at a predetermined ratio to the speeds of rotation of the chuck, and mechanism for varying said ratio.

73. A turret-lathe comprising a bed, a chuck, power devices for rotating said chuck at different predetermined speeds, a carriage, means for moving said carriage at different speeds at a predetermined ratio to the speeds of rotation of the chuck, a turret on said carriage, and mechanism controlled by said turret for automatically varying said ratio.

74. A turret-lathe comprising a bed, a carriage, a turret, a chuck-carrier, and fluid-operated mechanism for automatically imparting a predetermined speed of rotation to the chuck-carrier, irrespective of the resistance offered by the engagement of the different operating-tools with the work.

75. A turret-lathe comprising a bed, a carriage, a turret, a chuck-carrier, and automatic mechanism controlled by the turret, for imparting a differential movement to the chuck-carrier.

76. A turret-lathe comprising a bed, a carriage, a turret, a chuck-carrier, and automatic mechanism controlled by the turret for varying the speed of rotation of the chuck-carrier to correspond with the work to be done by the tools on the turret.

77. A turret-lathe comprising a bed, a carriage, a turret, a chuck-carrier, mechanism for rotating the chuck-carrier, and mechanism for varying the power imparted to the chuck-carrier and including a stop carrier or controller governed by the turret.

78. A turret-lathe comprising a bed, a carriage, a turret adapted to sustain a plurality of operating-tools, a chuck-carrier, mechanism for rotating said chuck-carrier, and mechanism including a stop-carrier having an adjustable stop for each tool, for automatically varying the speed of rotation of or power imparted to said chuck-carrier.

79. A turret-lathe comprising a bed, a carriage, a turret adapted to sustain a plurality of operating-tools, a chuck-carrier, mechanism for rotating said chuck-carrier, and mechanism including a stop-carrier having an adjustable stop for each tool, and a slide governed by the position of the operative stop, for automatically varying the speed of rotation of or power imparted to the chuck-carrier.

80. A turret-lathe comprising a bed, a carriage, a turret adapted to sustain a plurality of operating-tools, a chuck-carrier, mechanism for rotating said chuck-carrier, and mechanism including a stop-carrier having an adjustable stop for each tool and geared to the turret, and a slide governed by the position of the operative stop, for varying the speed of rotation of or power imparted to said chuck-carrier.

81. A turret-lathe comprising a bed, a carriage, a turret adapted to sustain a plurality of operating-tools, a chuck-carrier, mechanism for imparting motion to said chuck-carrier, said mechanism including a bladed wheel and a nozzle movable from the axis to the periphery of the wheel for delivering a stream of fluid against the blades of said wheel, and automatic devices for controlling said nozzle.

82. A device comprising a bed, a tool-carriage, a work-carrier, and mechanism for imparting motion to said work-carrier, said mechanism including a wheel having concentric rows of buckets or blades at different radii from the center thereof, a nozzle for discharging a stream of fluid against any of said rows of buckets or blades, and means for automatically varying the position of said nozzle.

83. A turret-lathe comprising a bed, a carriage, a turret adapted to sustain a plurality of operating-tools, a chuck-carrier, and mechanism for imparting motion to said chuck-carrier, said mechanism including a bladed wheel, a nozzle movable relatively to said wheel, and automatic turret-governed means for varying the position of said nozzle.

84. A turret-lathe comprising a bed, a carriage, a turret adapted to sustain a plurality of operating-tools, a chuck-carrier, and mechanism for imparting motion to said chuck-carrier, said mechanism including a bladed wheel, a nozzle movable relatively to said wheel, and an automatic controller having a series of stops for determining the position of the said nozzle.

85. A turret-lathe comprising a bed, a carriage, a turret adapted to sustain a plurality of operating-tools, a chuck-carrier, and mechanism for imparting motion to said chuck-carrier, said mechanism including a bladed wheel, a nozzle movable relatively to said wheel, a controller having a stop for each tool, and connections between the said stops and said nozzle, for determining the position of said nozzle.

86. A turret-lathe comprising a bed, a carriage, a turret adapted to sustain a plurality of operating-tools, a chuck-carrier, and mechanism for imparting motion to said chuck-carrier, said mechanism including a fluid-operated wheel, a series of stops rendered operative in succession, and devices coacting with said stops, for varying the direction of a stream of fluid against the said wheel.

87. A turret-lathe comprising a bed, a carriage, a turret adapted to sustain a plurality of operating-tools, a chuck-carrier, and mechanism for imparting motion to said chuck-carrier, said mechanism including a bladed fluid-operated wheel, and a nozzle for directing a stream of fluid on each side thereof.

88. A turret-lathe comprising a bed, a carriage, a turret adapted to sustain a plurality of operating-tools, a chuck-carrier, mechanism for imparting a differential movement to said carriage, mechanism for imparting a differential movement to said chuck-carrier, and an automatic controller having a series of stops for governing both of said mechanisms.

89. A turret-lathe comprising a bed, a carriage, a rotary turret, a fluid-operated carriage-feeding means, and a source of fluid-supply for delivering a variable volume of fluid to the said means, including a pump having a piston, an oscillating crank for reciprocating said piston, and mechanism for varying the path of movement of the said crank.

90. A lathe comprising a bed, a tool-carriage, a fluid-operated carriage-feeding means, and a source of fluid-supply for delivering a variable volume of fluid to the said means, including a pump having a piston, an oscillating crank for reciprocating said piston, a ratchet loose relatively to said crank, oppositely-arranged pawls on said crank to engage said ratchet, and automatic devices to render either of said pawls temporarily inoperative,

whereby the path of movement of the crank-arm and the stroke of the pump-piston are varied.

91. A lathe having a bed, a plate-shaped chuck-carrier, a central bearing on which said chuck-carrier is journaled, and a bearing for the front and rear faces of the outer portion of said carrier.

92. A lathe having a bed, a plate-shaped chuck-carrier, a central bearing on which said carrier is rotatably journaled and a bearing for the outer portion of said carrier, said carrier and said central bearing being apertured to receive the work.

93. A lathe having a bed, a ring-like head-stock thereon, a plate-shaped chuck-carrier journaled at its outer portion in said head-stock, and a bearing projecting centrally through said carrier and on which it is adapted to rotate.

94. A lathe having a head-stock, a plate-shaped chuck-carrier, a gib secured to said head-stock and overlapping the outer edges of said chuck-carrier to confine it against axial movement, and a central bearing for rotatably supporting said carrier.

95. A lathe having a circular plate-shaped chuck-carrier, centrally journaled, and gibbed at or near its margin whereby it is adapted to rotate upon its central bearing and is held against axial movement.

96. A lathe having a circular plate-shaped chuck-carrier, a support having an annular flange or sleeve on which said carrier is journaled at its center, and a gib for the outer edges of said carrier.

97. A lathe having a support which is provided with an annular sleeve or flange, a chuck-carrier journaled at or near its center on said sleeve or flange, and a ring-like head-stock encircling said carrier and having a gib to hold it against axial movement.

98. A lathe having a ring-like head-stock with an inwardly-projecting flange or gib, a chuck-carrier inside of said head-stock, a plate secured to said head-stock and coacting with said flange or gib to hold said carrier against axial movement, and a bearing supported by said plate on which said carrier is journaled.

99. A lathe having a chuck-carrier, a head-stock in which said chuck-carrier rotates, antifriction devices between said carrier and said head-stock, and a bearing on which said carrier is journaled at or near its center.

100. A lathe having a ring-like head-stock with an internal flange, a stationary plate secured in said head-stock, a plate-shaped chuck-carrier in said head-stock and confined at its outer edges between said plate and said flange, antifriction devices inserted between the chuck-carrier and the flange, and the chuck-carrier and the plate, and a bearing on which said chuck-carrier is journaled at or near its center.

101. A lathe having a ring-like head-stock with an internal flange, a stationary plate secured in said head-stock, a plate-shaped chuck-carrier in said head-stock and confined at its outer edges between said plate and said flange, antifriction devices inserted between the chuck-carrier and the flange, and the chuck-carrier and the plate, retainers or separators for said antifriction devices, and a bearing on which said chuck-carrier is journaled at or near its center.

102. A lathe having a ring-like head-stock, a flat chuck-carrier within said head-stock and held only against axial movement thereby, and a tubular bearing on which said chuck-carrier is journaled at or near its center.

103. A lathe having a ring-like head-stock, a plate-shaped chuck-carrier in said head-stock and having its front face flush therewith, a chuck secured to the said front face and overlapping the head-stock, and a bearing for the outer edges of the said chuck-carrier.

104. A lathe having a ring-like head-stock with an internal flange, a stationary plate formed with a hub and secured in said head-stock, a plate-shaped chuck-carrier journaled on said hub and having its outer edge between the said internal flange and the said plate, and a tapering bearing-sleeve between the said hub and the said chuck-carrier.

105. A lathe having a flat plate-shaped chuck-carrier journaled at its center and gibbed at its edges, and formed with peripheral gear-teeth.

106. A lathe having a chuck-carrier, a bed, a carriage, a turret having provisions for receiving a plurality of tools, a clutch mechanism for the chuck-carrier, and an automatic turret-governed controlling mechanism for operating the said clutch.

107. A lathe having a chuck-carrier, a bed, a carriage, a turret having provisions for receiving a plurality of tools, means for rotating the chuck-carrier, and a controller for said means, including a stop for each tool on the turret, whereby the rotation of the chuck-carrier may be varied or stopped, as desired.

108. A lathe having a chuck-carrier, a bed, a carriage, a turret having provisions for receiving a plurality of tools, means including a clutch, for rotating the chuck-carrier, and a controller for said means, geared to rotate with the turret, whereby the said clutch may be automatically operated according to the tool then in operative position.

109. A lathe having a chuck-carrier, a bed, a carriage, a turret having provisions for receiving a plurality of tools, means including a clutch for rotating the chuck-carrier, and a controller including an adjustable stop for each tool on the turret and stop-operated plungers for operating the said clutch.

110. A lathe having a chuck-carrier, a bed, a carriage, a turret having provisions for receiving a plurality of tools, clutch mechanism including a movable member for rotating the chuck-carrier, and an automatic controller for shifting said member to operate the clutch mechanism.

111. A lathe having a chuck-carrier, a bed, a carriage, a turret having provisions for receiving a plurality of tools, clutch mechanism including a movable member for rotating the chuck-carrier, and automatically-actuated dogs for shifting said member to operate the clutch mechanism which transmits power to the chuck-carrier.

112. A lathe having a chuck-carrier, a bed, a tool-carriage, and back-gear clutch mechanism, including a movable member for rotating the chuck-carrier, and movable dogs for shifting said clutch member to operate the back-gear clutch.

113. A lathe having a chuck-carrier, a bed, a carriage, a turret having provisions for receiving a plurality of tools, clutch mechanism including a movable member for rotating the chuck-carrier, movable dogs for shifting said clutch member to change the speed or stop the rotation of the chuck-carrier, and a series of turret-controlled stops for governing said dogs.

114. A lathe having a chuck-carrier, a bed, a carriage, a turret having provisions for receiving a plurality of tools, clutch mechanism including a movable member for rotating the chuck-carrier, and dogs for shifting said member, said member having provisions for returning said dogs to normal position.

115. A lathe having a chuck-carrier, a bed, a carriage, a turret having provisions for receiving a plurality of tools, clutch mechanism including a movable member for rotating the chuck-carrier, said member being formed with a cam, and a plurality of dogs to engage said cam and shift the member, for the purpose of operating the said clutch mechanism.

116. A lathe having a chuck-carrier, a bed, a carriage, a turret having provisions for receiving a plurality of tools, clutch mechanism including a movable member for rotating the chuck-carrier, said member being formed with a cam, a plurality of automatically-operated dogs to engage said cam and shift the member, and an automatic controller having a series of stops for governing the action of said dogs.

117. A lathe having a back-gear clutch, and a plurality of independent dogs arranged and adapted to shift said clutch to either operating position or therefrom to a neutral position.

118. A lathe having a bed, a ring-like head-stock and a chuck-carrier gibbed at its edges in the head-stock, said head-stock being provided with wing-like extensions projecting in the front and rear of the chuck-carrier.

119. A lathe having a bed, a ring-like head-stock, and a chuck-carrier mounted in said head-stock, said head-stock being provided with forwardly and rearwardly projecting wings or extensions extending below the top surface of the bed and merging into the bed.

120. A lathe having a bed with a vertical head-stock arising at one end thereof, said head-stock being externally convex, and carried below the upper surface of the bed, with provisions for receiving a chuck-carrier.

121. A lathe having a bed with a vertical head-stock arising at one end thereof, said head-stock having provisions for receiving a chuck-carrier, and having apertures for permitting the passage of shear-protectors traveling with the carriage.

122. A lathe having a bed with suitable ways or shears, a carriage sliding on said ways or shears, shear-protectors secured to said carriage and partially surrounding said ways or shears, and a head-stock at one end of the bed, projecting laterally beyond the ways or shears, and having apertures to receive the said shear-protectors.

123. A turret-lathe comprising a bed, a carriage, a rotary turret having provisions for receiving a plurality of operating-tools, and a chuck-carrier, combined with an automatic controller for the carriage, an automatic controller for the chuck-carrier, and connections between the said controllers and the turret.

124. A turret-lathe comprising a bed, a carriage, a rotary turret having provisions for receiving a plurality of operating-tools, a rotating chuck-carrier, provisions for advancing and withdrawing the carriage different predetermined distances for a number of times equal to the number of operative tools, and automatic provisions controlled by the turret for rotating the chuck-carrier with different predetermined speeds, in accordance with the character of the tools.

125. A lathe having a bed, a head-stock formed on or secured to said bed, said head-stock being ring-like in end elevation to receive a chuck-carrier, and being substantially ovoid in side elevation, whereby it is strengthened to resist the strains occasioned by the engagement of a tool with the work.

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

JAMES HARTNESS.

Witnesses:
M. B. MAY,
E. BATCHELDER.