H. E. TEMPLE & O. L. DOSCH.

DRILLING MACHINE.

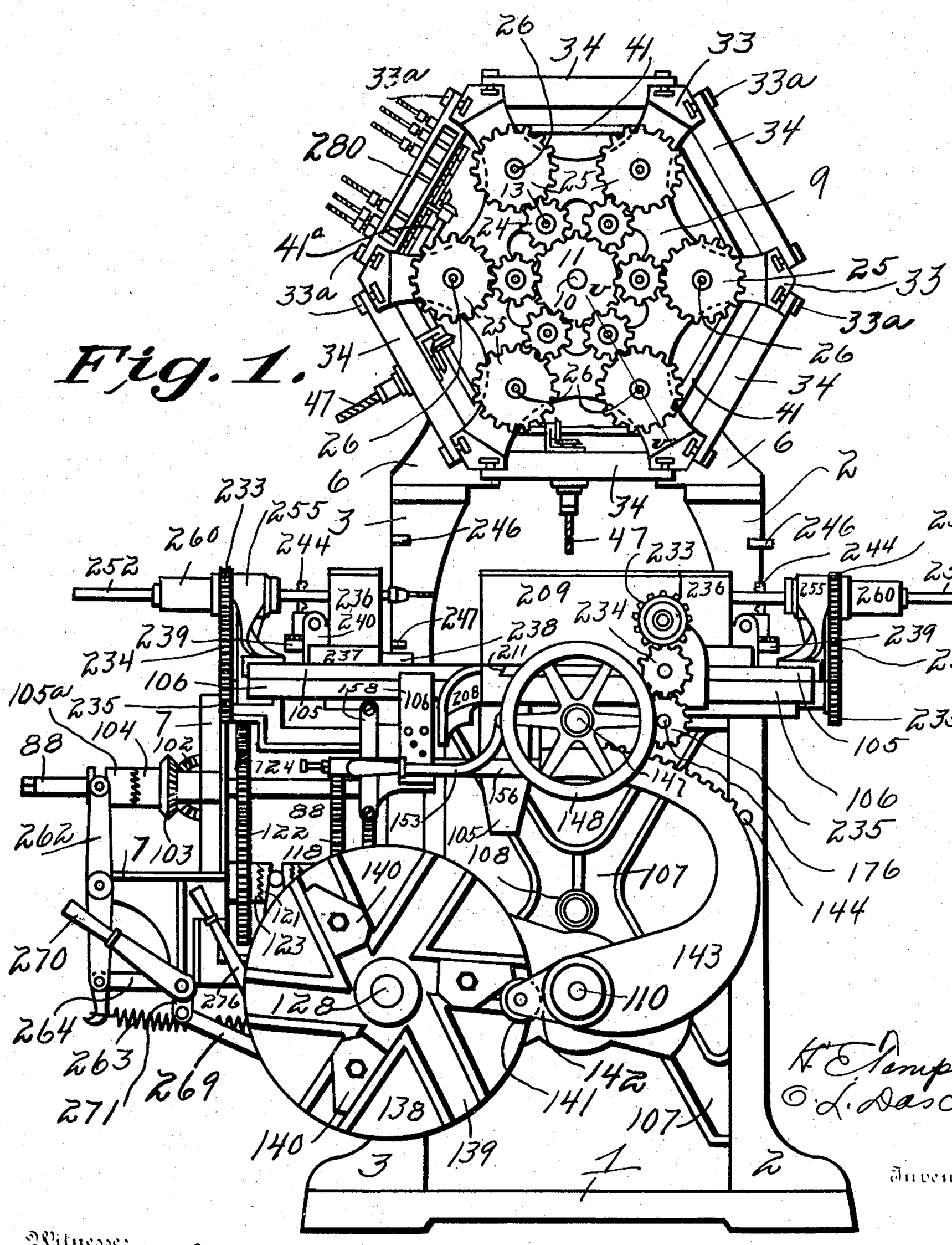
APPLICATION FILED APR. 15, 1907.

931,001.

Patented Aug. 10, 1909.

15 SHEETS—SHEET 1

Fig. 1.



Witnesses.

Matthew Sieber

E. M. Theobald

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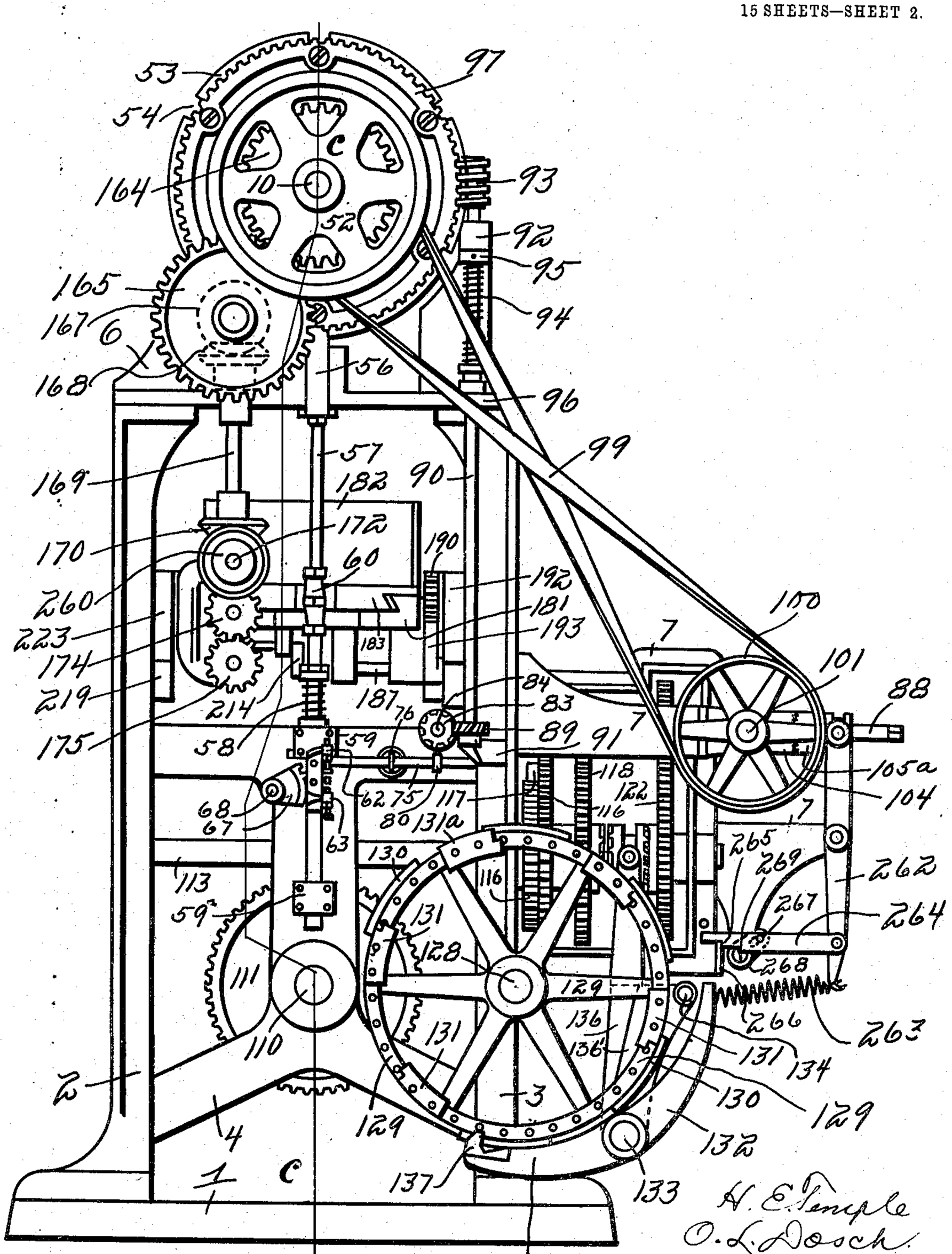

Fig. 2.

Witnesses

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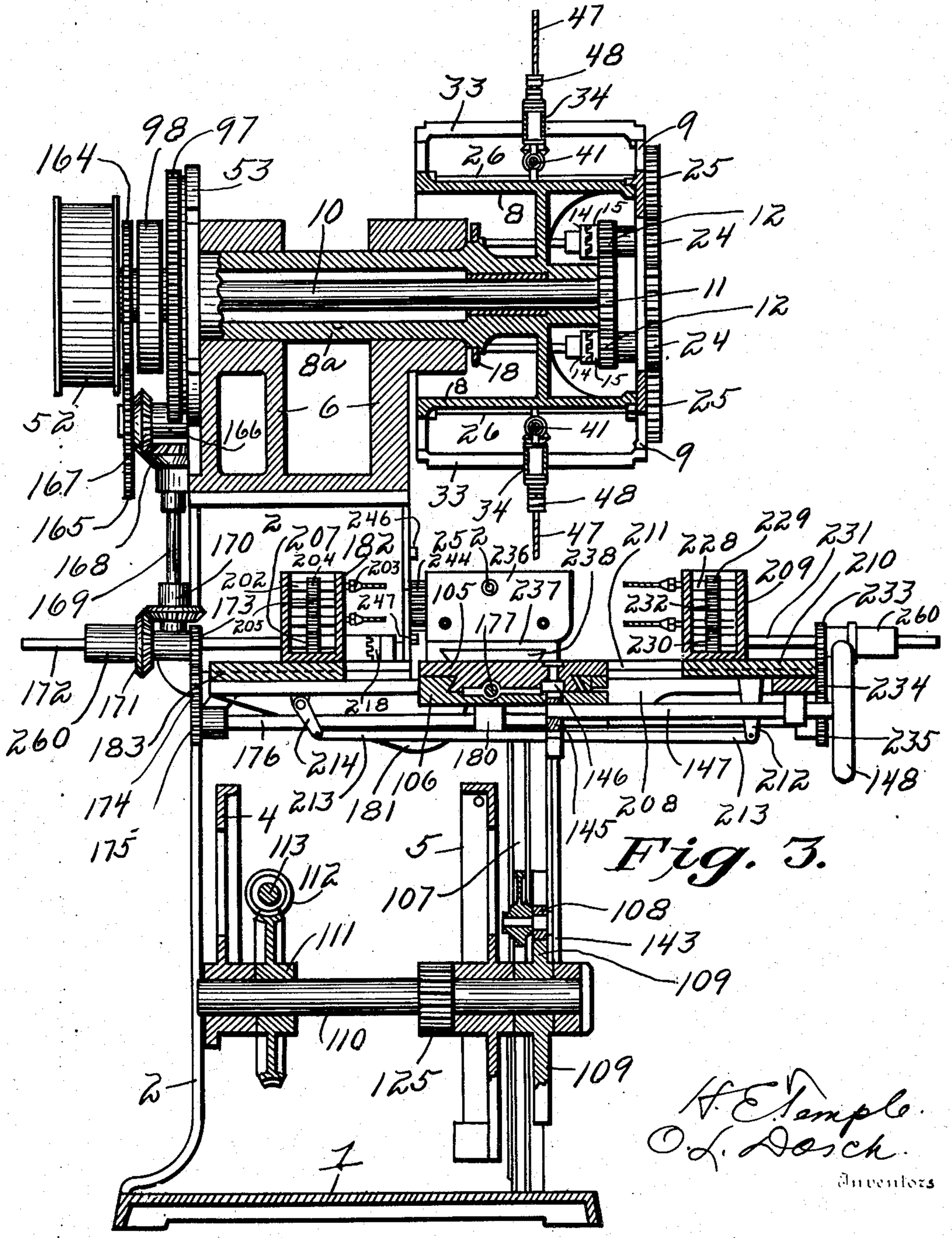

Fig. 3.

Witnesses

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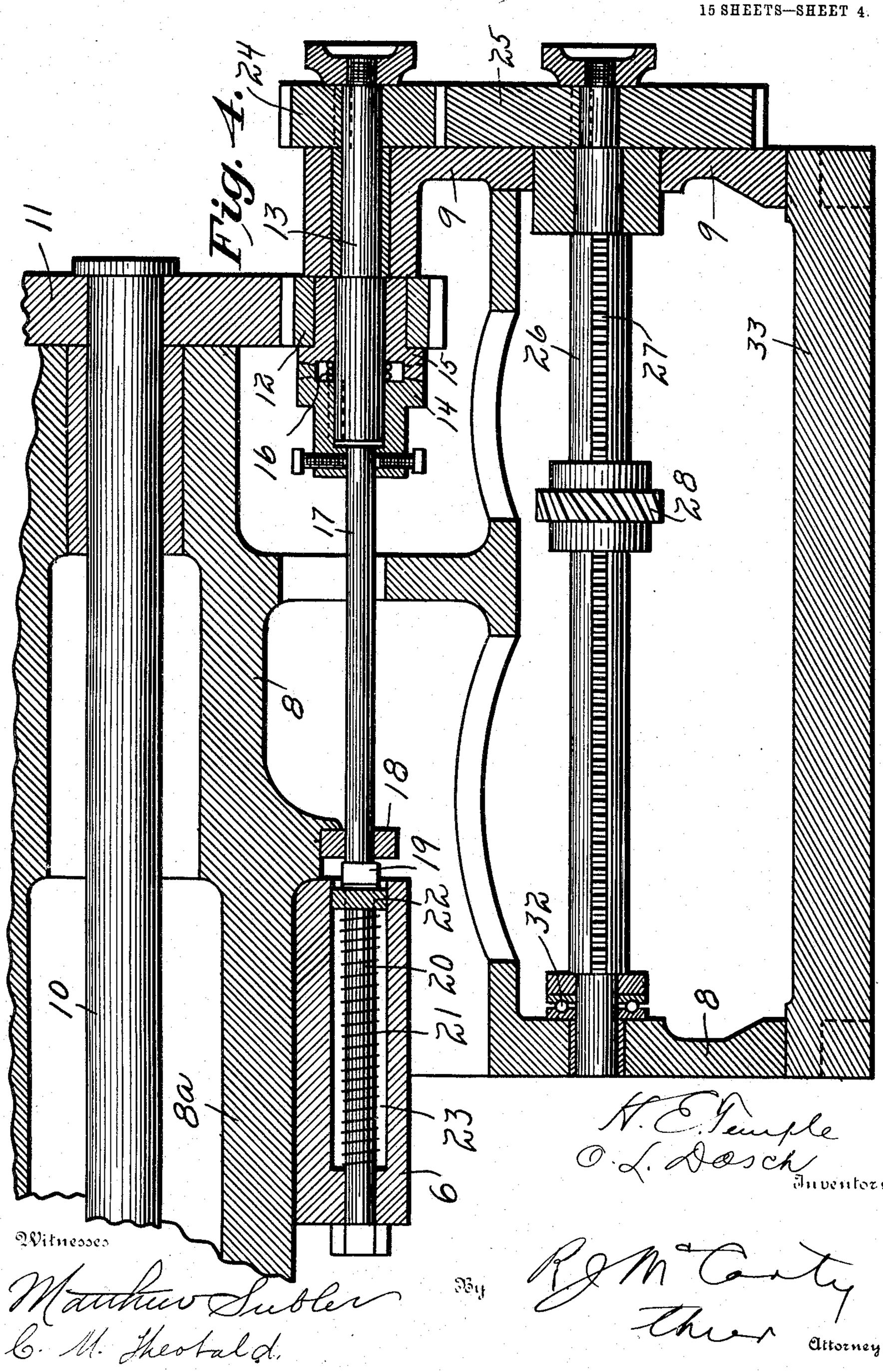
15 SHEETS—SHEET 4.

Fig. 4.



Witnesses

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15 SHEETS—SHEET 5

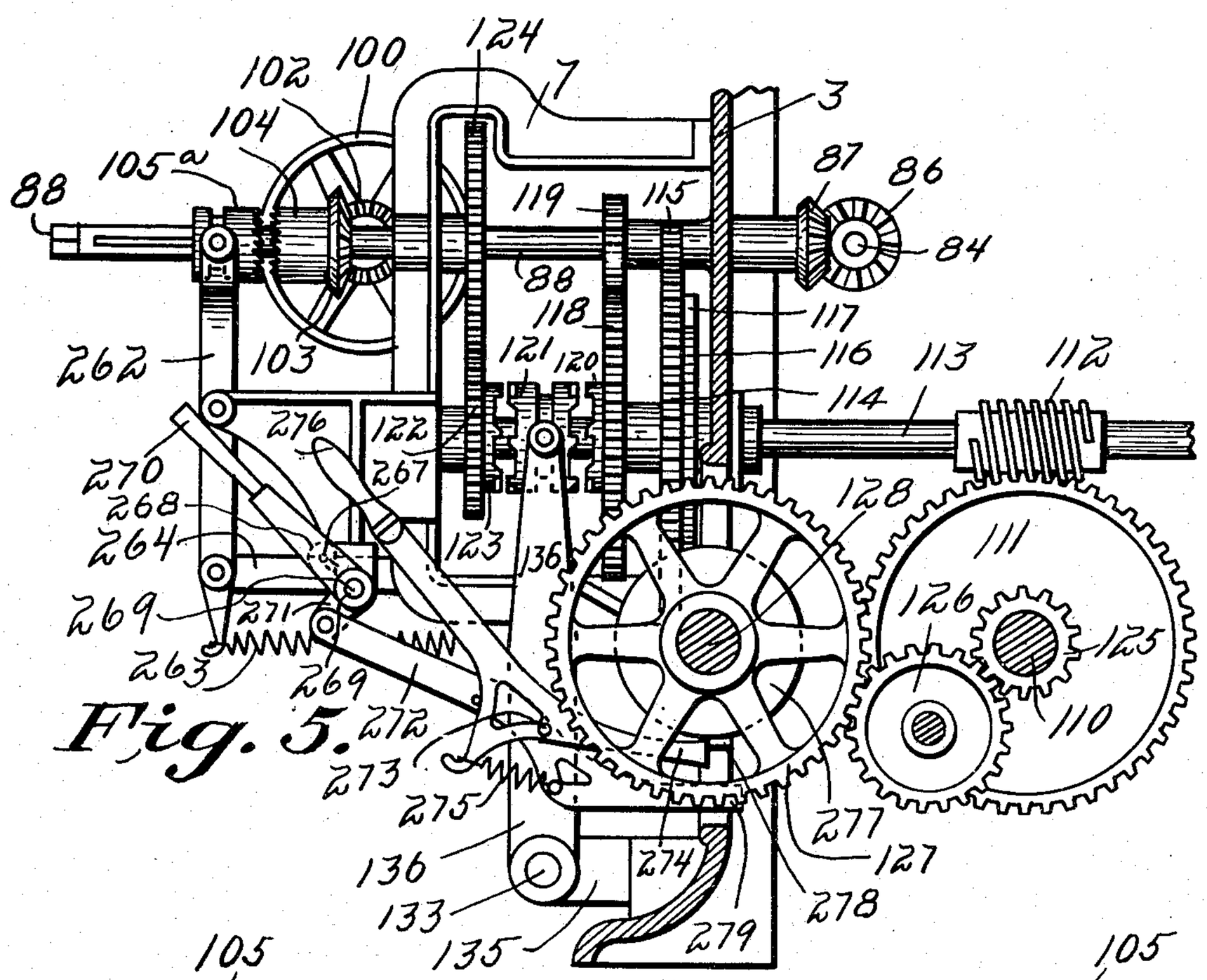

Fig. 5.

Fig. 6.

Witnesses
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15 SHEETS—SHEET 6

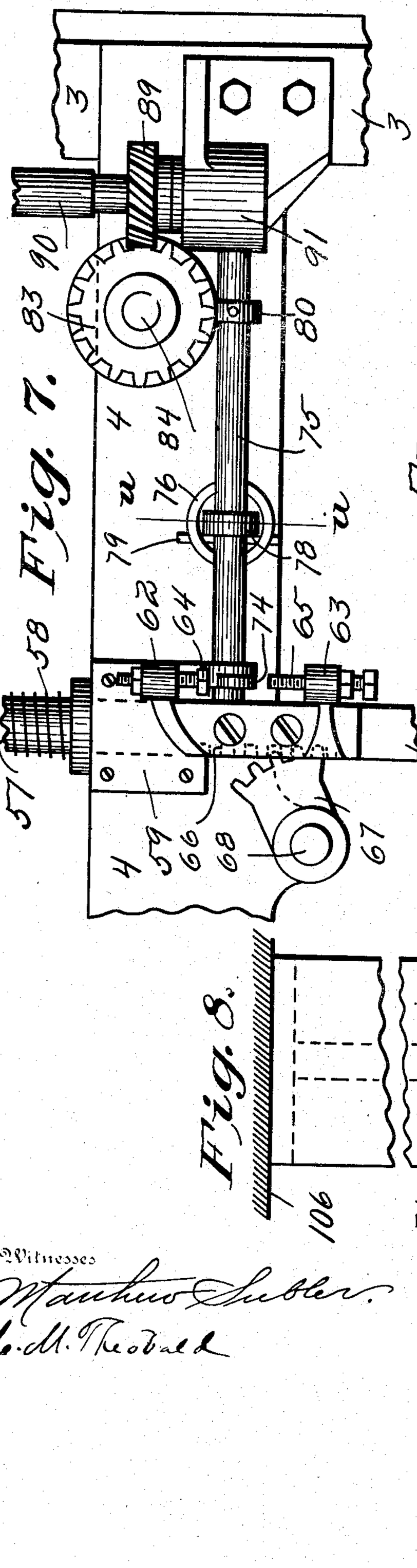

Fig. 7.

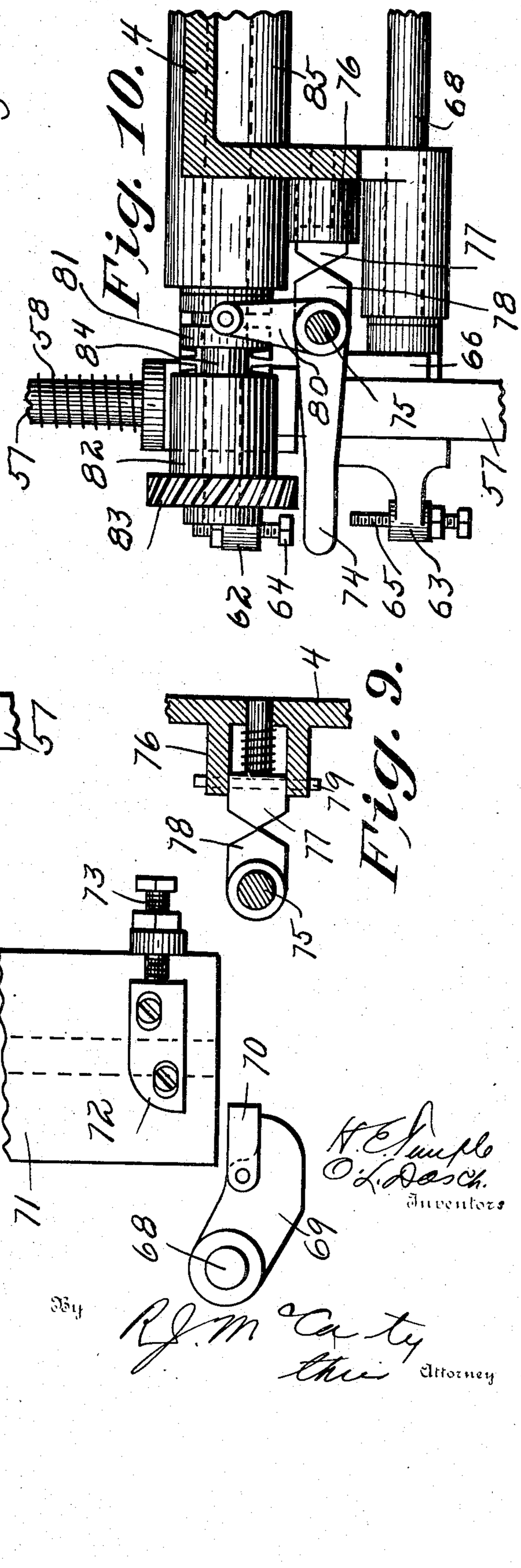

Fig. 10.

Fig. 9.

Fig. 8.

Witnesses

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DRILLING MACHINE.

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15 SHEETS—SHEET 7.

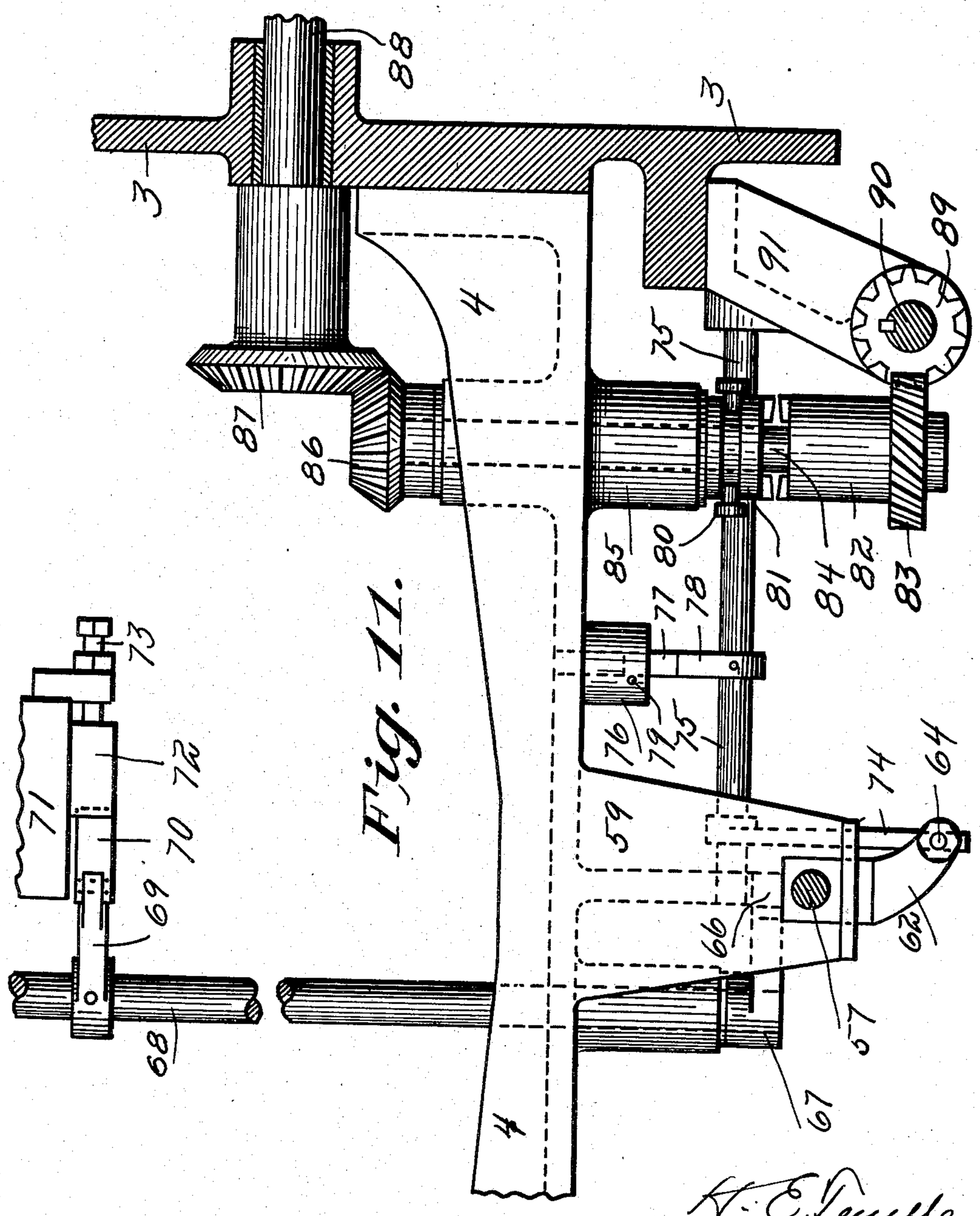

Fig. 1.

Witnesses
Matthew Sibler
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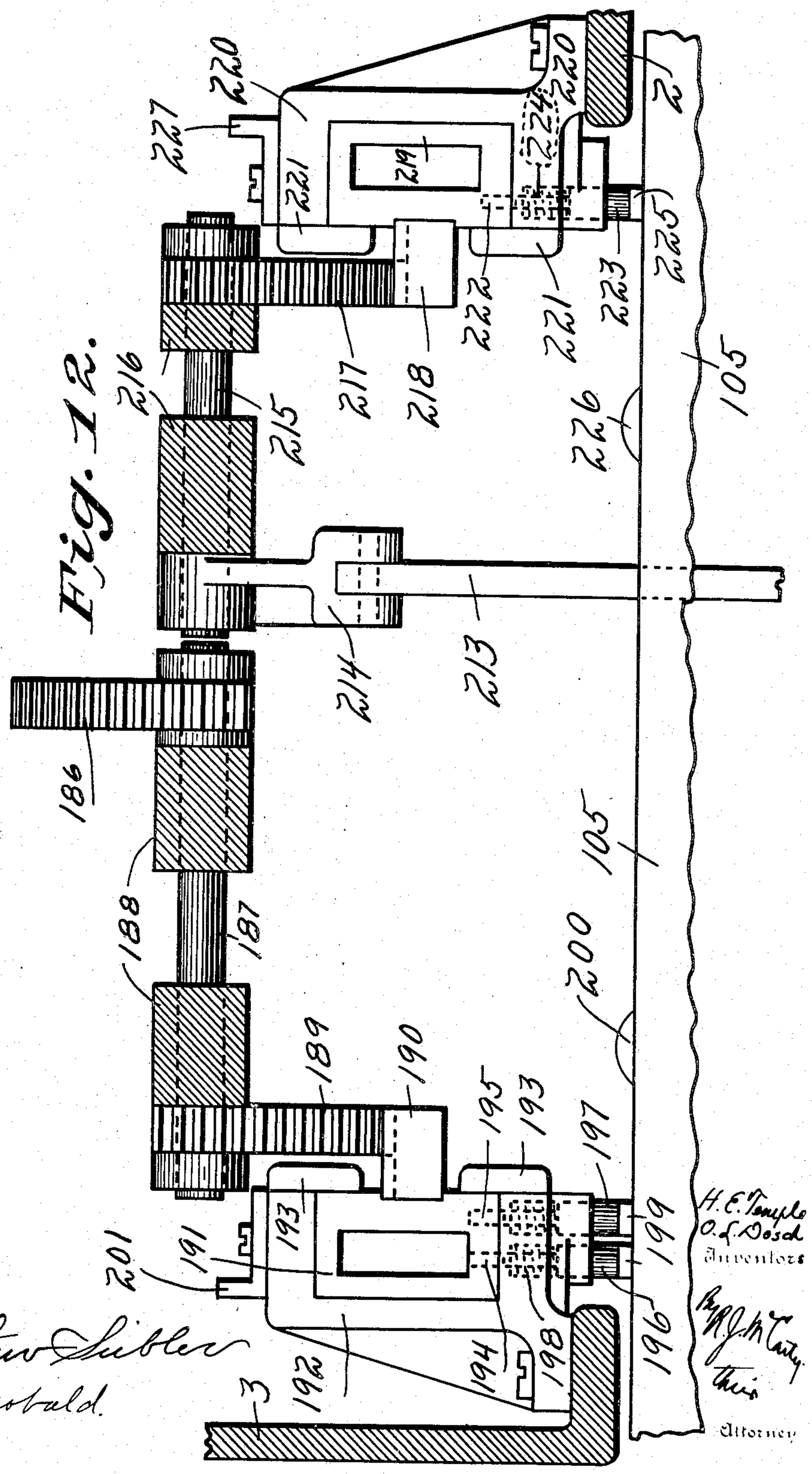
DRILLING MACHINE.

APPLICATION FILED APR. 15, 1907.

Patented Aug. 10, 1909.

15 SHEETS—SHEET 8.

Fig. 12.



Witnesses
Matthew Sibler
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DRILLING MACHINE.

APPLICATION FILED APR. 15, 1907.

931,001.

Patented Aug. 10, 1909.

15 SHEETS—SHEET 9.

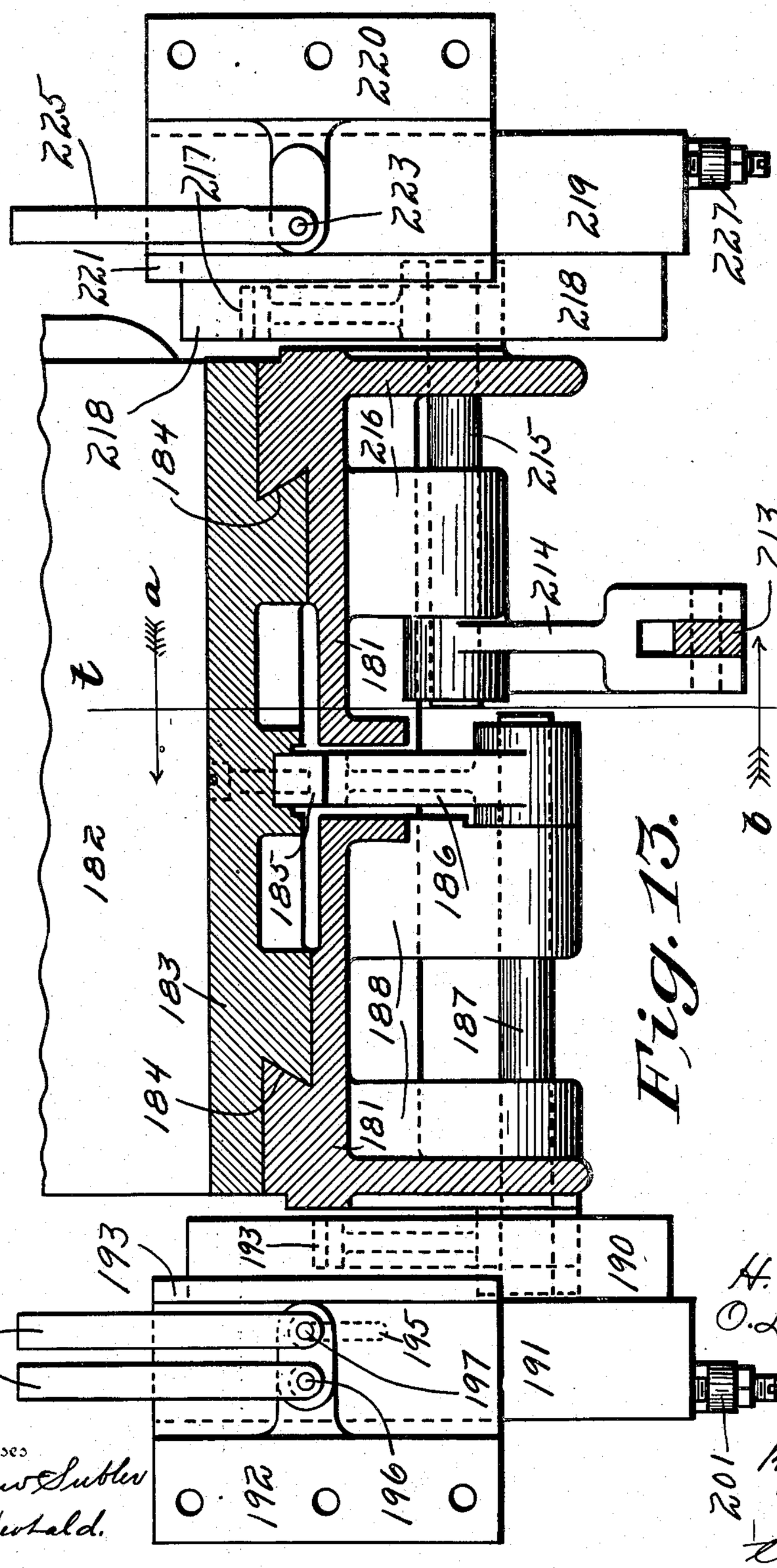

Fig. 13.

Witnesses
Matthew Stubler
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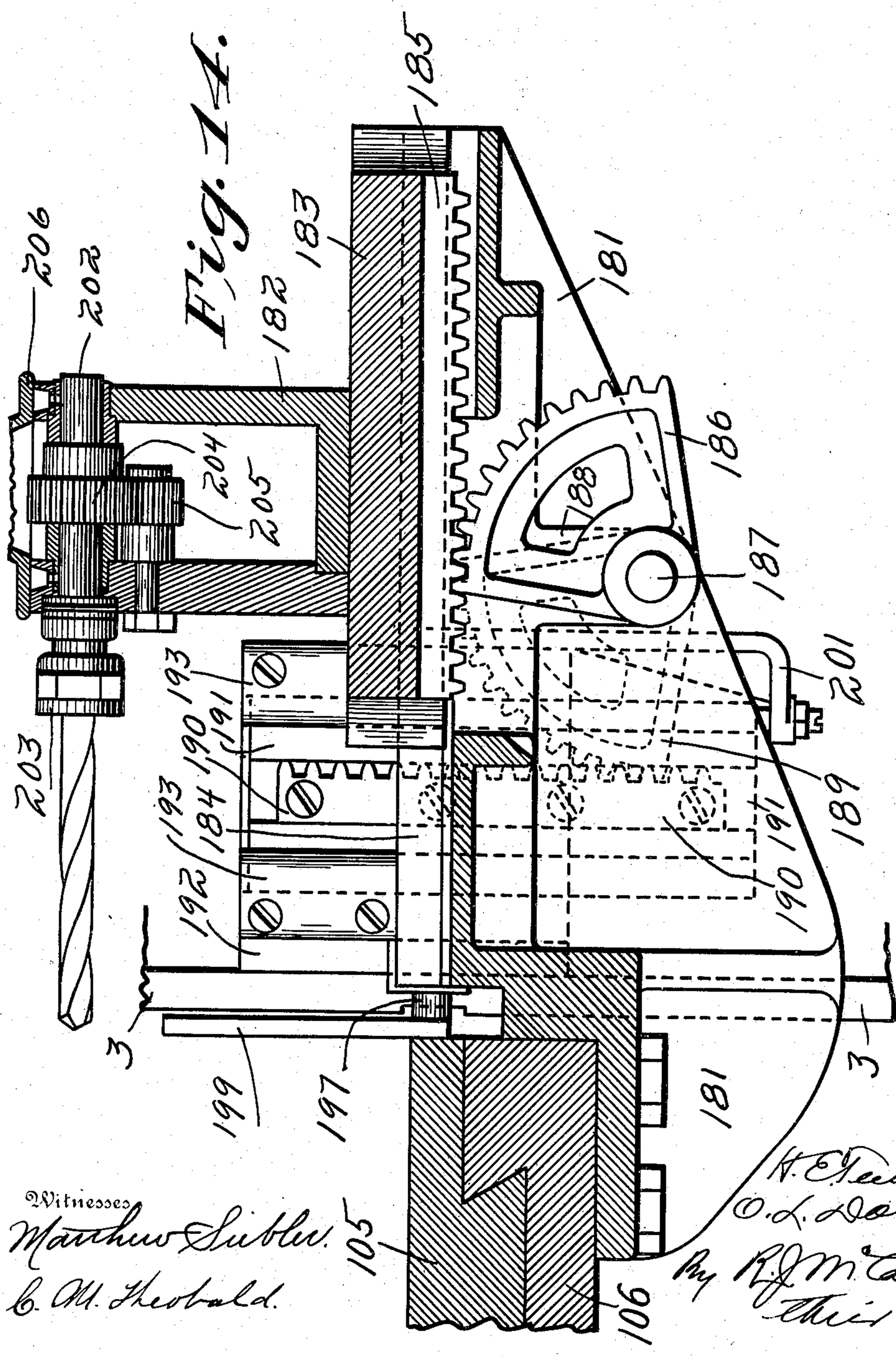
DRILLING MACHINE.

APPLICATION FILED APR. 15, 1907.

931,001. Patented Aug. 10, 1909.

15 SHEETS—SHEET 10

Fig. 14.



931,001.

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DRILLING MACHINE.

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Patented Aug. 10, 1909.

15 SHEETS—SHEET 11.

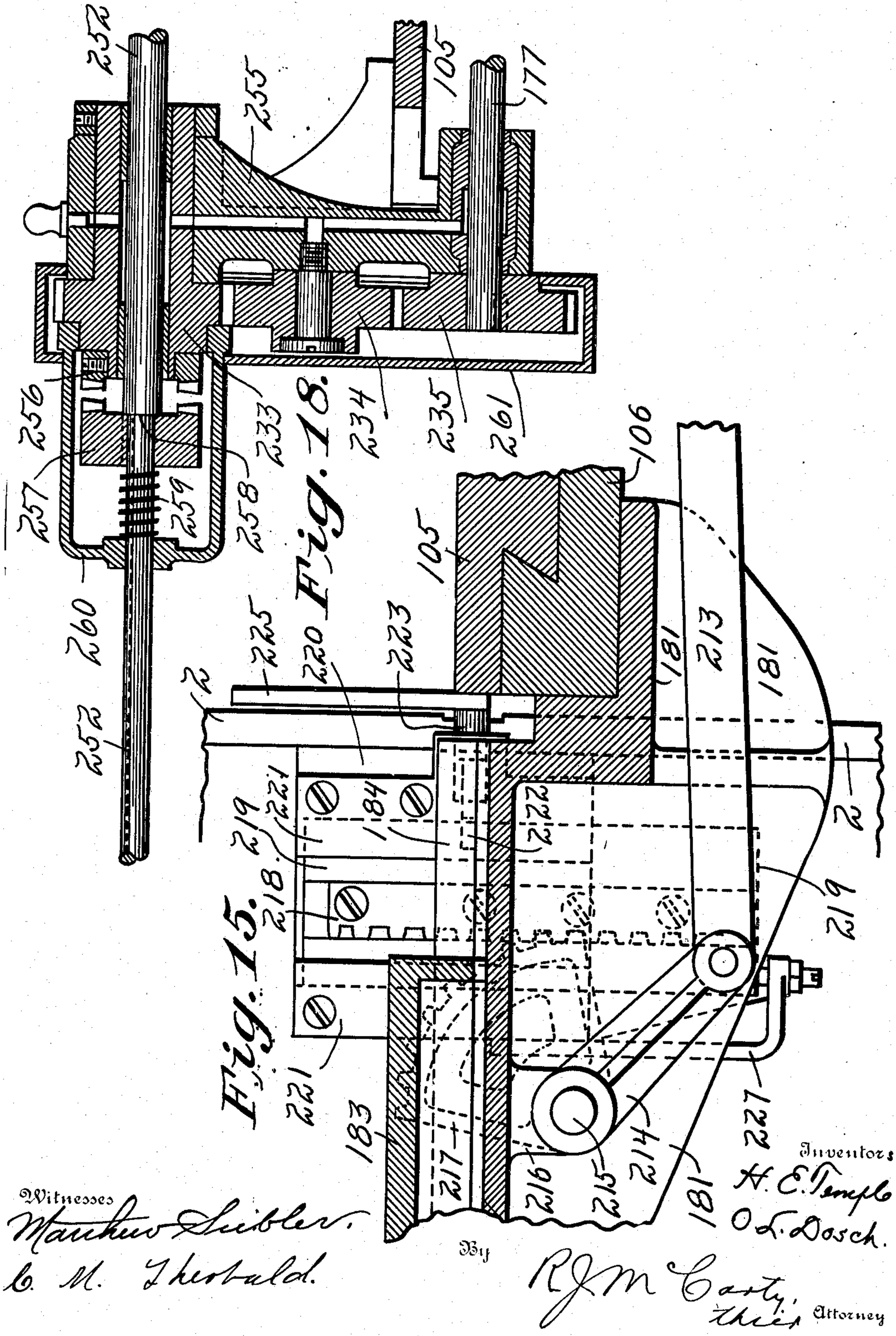

Fig. 18.

Fig. 15.

Witnesses
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DRILLING MACHINE.

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15 SHEETS—SHEET 12.

Fig. 16.

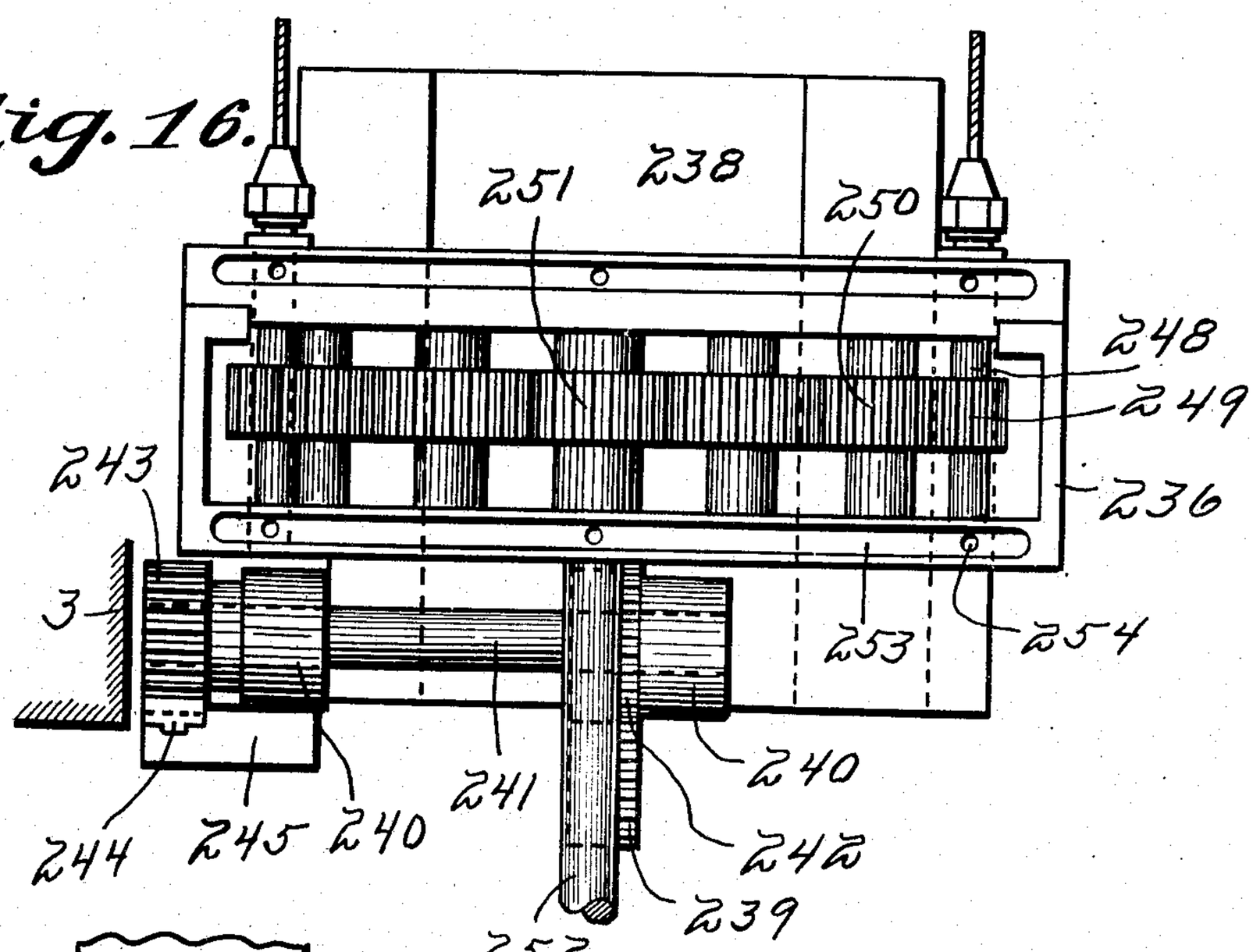

Fig. 17.

Witnesses

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DRILLING MACHINE.

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15 SHEETS—SHEET 13.

Fig. 20.

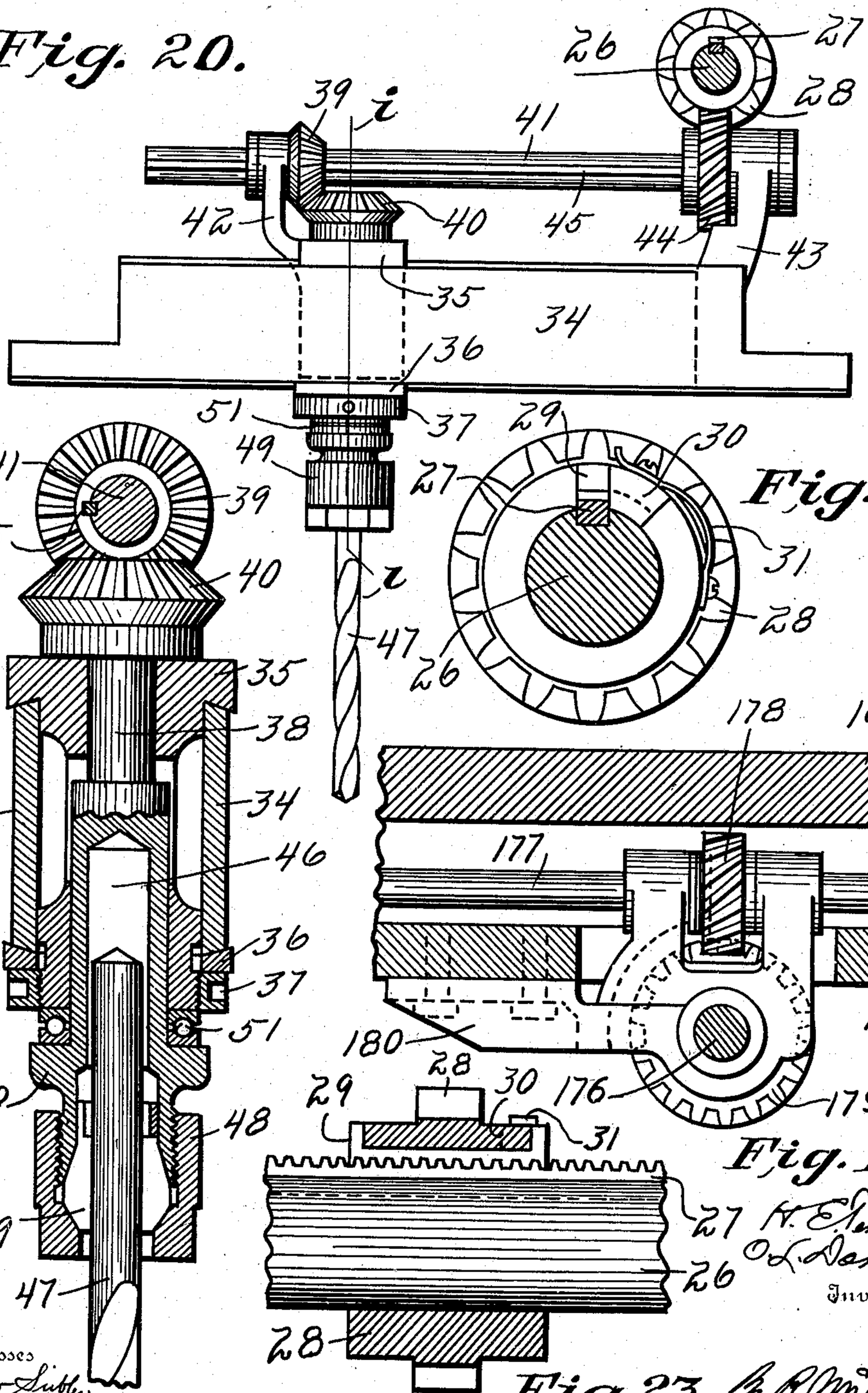

Fig. 22.

Fig. 19.

Witnesses
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Fig. 21.

Fig. 23.

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15 SHEETS—SHEET 14.

Fig. 24.

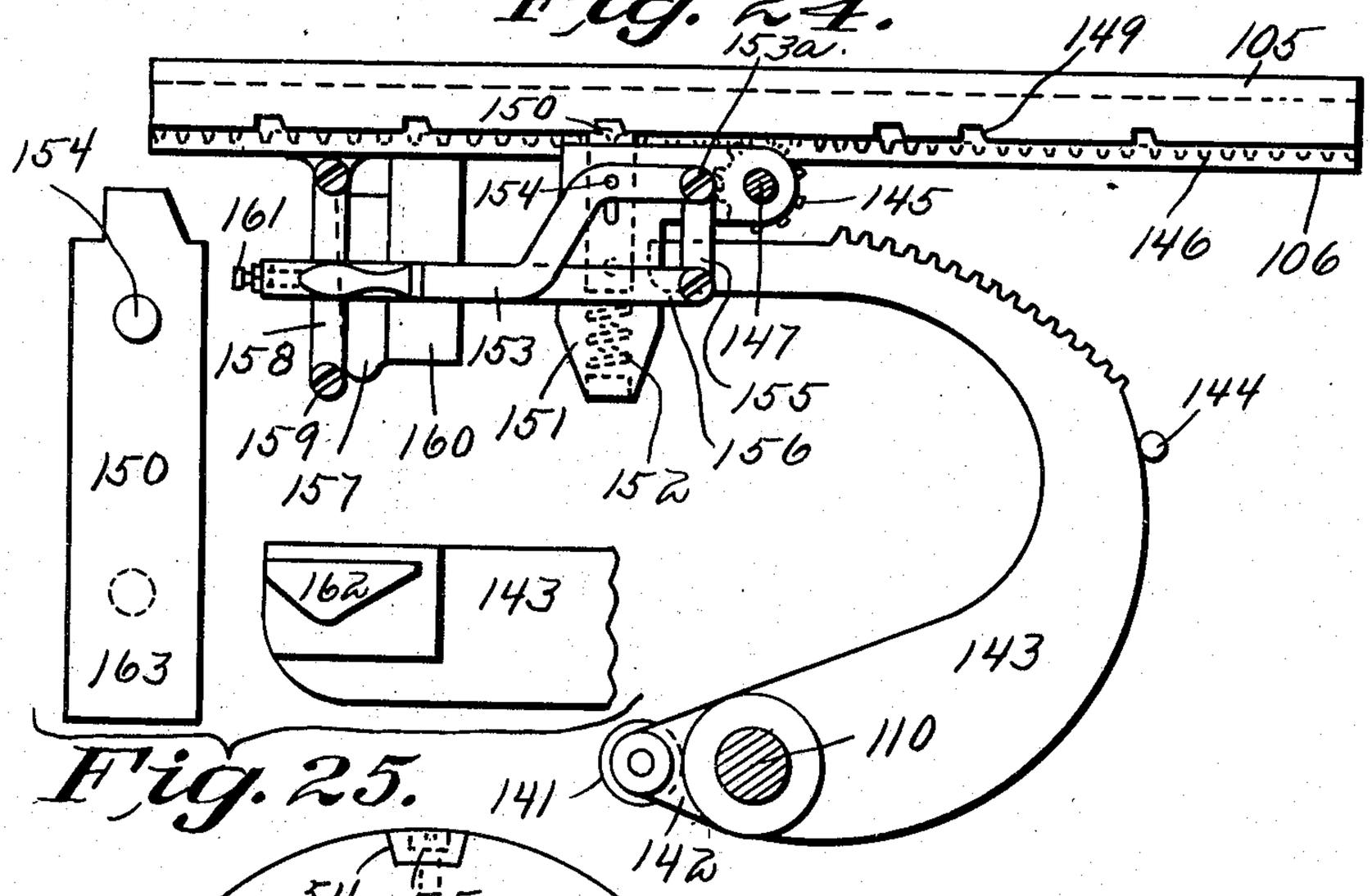

Fig. 25.

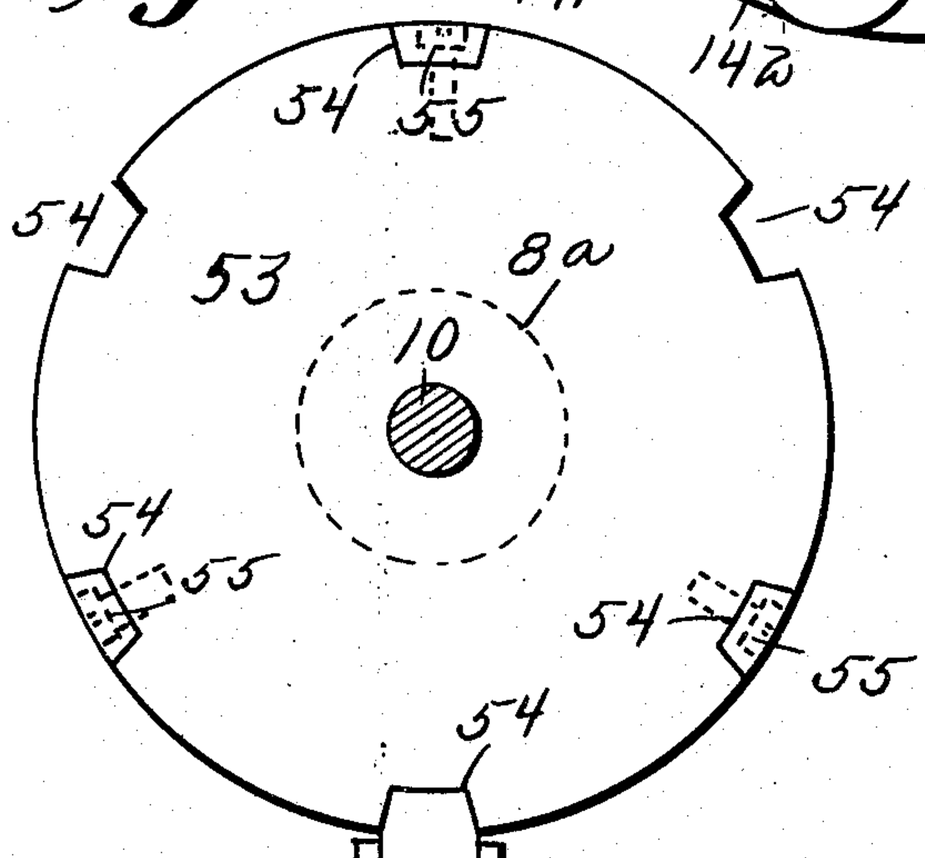

Fig. 26

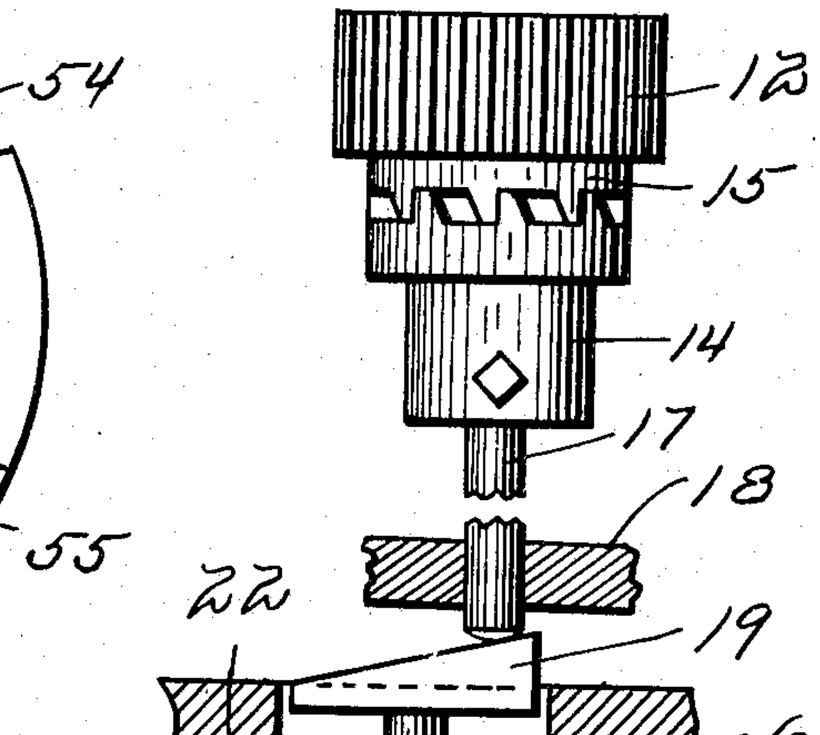

Fig. 27.

Witnesses:

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15 SHEETS—SHEET 15.

Fig. 29.

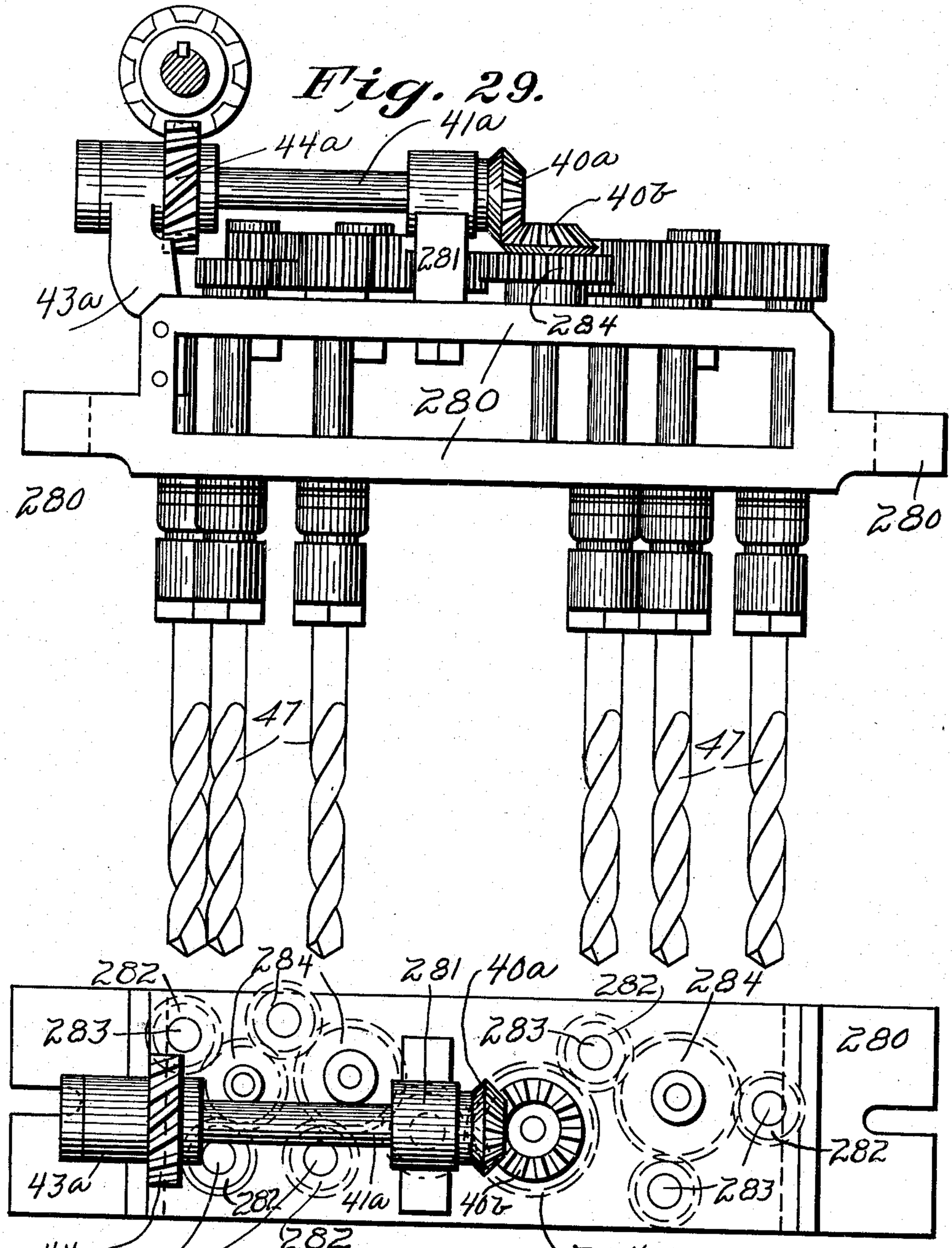

Fig. 28.

Witnesses

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UNITED STATES PATENT OFFICE.

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DRILLING-MACHINE.

No. 931,001. Specification of Letters Patent. Patented Aug. 10, 1909.

Application filed April 15, 1907. Serial No. 368,426.

To all whom it may concern:

Be it known that we, HARRY E. TEMPLE and OLIVER L. DOSCH, citizens of the United States, residing, respectively, at Weehawken, county of Hudson, State of New Jersey, and Dayton, county of Montgomery, State of Ohio, have invented certain new and useful Improvements in Drilling-Machines; and we do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

This invention relates to an automatic multiple spindle drilling machine, and is an improvement of the automatic multiple spindle drilling machine patented March 8, 1904, No. 753,905, which patent has been assigned to the National Automatic Tool Co., of Dayton, Ohio, the assignee of the present invention.

The object of the present invention is to increase the utility and effectiveness of the drilling machine of the prior patent, and with this end in view the present invention consists first—in means whereby five sides or surfaces of a piece to be worked upon may be drilled at one and the same time; second—means whereby the drills on the turret head may be removed and replaced with greater facility than heretofore; third—means whereby the turret-head is indexed more positively and accurately than heretofore; fourth—certain improved means in the starting and stopping mechanism of the machine; fifth—means whereby the turret-head-rotating mechanism and the platen driving mechanism are all controlled through one initial driving medium at the turret-head; sixth—and certain improvements in the means for timing the operations of the platen.

Preceding a more detailed description of the invention reference is made to the accompanying drawings, of which—

Figure 1, is a front elevation of the machine. Fig. 2, is a rear elevation. Fig. 3, is a longitudinal-vertical-sectional elevation on the line *c*—*c* of Fig. 2. Fig. 4, is an enlarged sectional view on the line *v*—*v* of Fig. 1. Fig. 5, is a detail view of the starting mechanism, also the change-speed mechanism for raising the platen. Fig. 6, is a detail view of the means for raising the platen. Figs. 7 and 8, detail views of means for indexing the turret-head. Fig. 9, a sectional view on the line *u*—*u* of Fig. 7. Fig. 10, a right hand side elevation of Fig. 7. Fig. 11, a top plan view of the means for indexing the turret-head. Fig. 12, a top plan view of the means for feeding the front and rear horizontal drill boxes. Fig. 13, a front elevation of Fig. 12. Fig. 14, an enlarged sectional view on the line *t*—*t* of Fig. 13, looking in the direction of the arrow (*a*) showing means for feeding the rear horizontal drill box. Fig. 15, an enlarged sectional view on the line *t*—*t* of Fig. 13, looking in the direction of the arrow (*b*) showing the means for feeding the front horizontal drill box. Fig. 16, an enlarged top plan view of the side horizontal drill boxes with their gearing and means for feeding the same. Fig. 17, a side elevation of the mechanism of Fig. 16. Fig. 18, an enlarged sectional view of the clutches and the transfer gears of the horizontal drill boxes; this mechanism is common to all of the horizontal drill boxes. Fig. 19, a detail view of the spiral gears for rotating the driving shaft for the side horizontal drill boxes. Fig. 20, a detail view of one of the drill rails of the turret-head. Fig. 21, a sectional view on the line *i*—*i* of Fig. 20. Figs. 22 and 23, are detail views of the adjustable spiral gear for the turret-head drill rails. Fig. 24, is a detail view of the platen-indexing mechanism. Fig. 25, is a detail view of the means for releasing the shot bolt of the platen-indexing mechanism. Fig. 26, is a detail of the shot bolt of the turret-head indexing mechanism. Fig. 27, is a detail view of the clutch-controlling cam and associated parts of the turret-head indexing mechanism. Fig. 28, is a top plan view of a drill bar with drills, spindles and their gearing, detached from the turret-head. Fig. 29, is a side elevation of the drill bar shown in Fig. 28.

Throughout the specification, similar reference characters indicate corresponding parts.

Main frame-work.—This feature of the invention is best illustrated on Sheets 1—2 and 3 of the drawings where 1 designates the base plate upon which are mounted two side plates 2 and 3 which are connected at their lower portion by a rear cross frame 4 and front cross frame 5. The upper por-

tions of the side plates are connected by the turret-head bearing standards 6. Extending from the left hand side of the machine, and attached to the side plate 3 is a variable speed driving gear frame 7 for supporting the gears for driving the platen. All of the above specified parts are suitably united by bolts and screws.

Turret-head mechanism.—This mechanism is best shown in Figs. 1—3—4—20—21—22—23 and 26, where 8 designates the turret-head frame mounted in the bearing standards 6, and 9 is the front plate of the turret-head extending from the main frame of the turret-head. Extending through the hub 8ª of the turret-head is a main driving shaft 10 having on one end a master gear 11 which engages six small pinions forming transmission gears 12 which in turn, are loosely mounted upon a transmission shaft 13.

14 and 15 designate two members of a clutch, the former member, to-wit—14 is splined to the shaft 13, and the latter member to-wit—15 is rigidly attached to the transmission gear 12. At this point it will be borne in mind that only those drills on the lower face of the turret-head rotate, and for these drills the clutch devices just referred to are intended, said clutch devices serving to throw the drills in gear at the proper time, for example, referring to Fig. 1, the lower right hand gear 25 is connected through the clutch members 14 and 15 and the pinion 24, therefore, receives movement from the master gear 11. The movable member 14 is provided with an inclosed spring 16 which normally tends to separate the clutches, and said movable clutch member is connected with a shot bolt 17 which receives a supporting ring 18 at its other extreme end, said supporting ring being attached to the turret-head frame 8. Adapted to engage the extreme free end of the shot bolt 17, is an inclined cam which may be termed a clutch-controlling cam; this cam is on a supporting rod 20 which is slidingly supported in an extension of the turret-head bearing standards 6, and said rod is provided with a guide-piece 22 which is rigid thereon and incloses at one end a spring 21 surounding said rod; this spring lies within the opening 23 in the bearing standards piece, and the purposes of said spring are to maintain a suitable contact between the cam 19 and the end of the shot bolt 17 and to permit said cam to yield when the teeth of the respective clutch members 14 and 15 come in alinement, or in such positions that do not permit of an engagement of the clutches; when the clutches are in a position to interlock, the effect of the spring 21 is to move the shot bolt 17 with the clutch member 14 to such interlocking position. When the clutch members are thrown in as shown in Figs. 4 and 27, the gears 24 and 25 are driven from the master gear and the spindles or drills in the lower position on the turret-head are being driven.

Each of the driving gears 25 is mounted upon a shaft 26 which is journaled at its forward end in the front plate 9 of the turret-head, and at its rear end in the main turret-head frame 8; and has an anti-friction end thrust bearing 32; upon each of these shafts 26 there are one or more spiral gears 28 which are movable to any suitable point along the shaft 26 and are maintained in such position for the purposes and by the means as follows: 33 designates slotted bars supporting the side frames of the drill rails 34; these slotted bars 33 are rigidly attached to the front plate 9 of the turret-head and the main turret-head frame 8. The side frames 34 of the drill rails are attached to the slotted bars 33 by means of bolts 33ª; the heads of said bolts working in T-slots in the slotted bars 33 which permit of said drill rails to be moved along the bars 33 to any position. This adjustment of the side frames of the drill rails renders necessary the proper positioning of the spiral gear 28 or the spiral gears 28 if there are more than one upon the shaft 26. This spiral gear 28 is moved and locked in position through means of a rack bar 27 which extends along one side of the shaft 26 and is adapted to engage with a toothed key 29 which lies within the opening of the spiral gear and engages the teeth of the rack bar at such times when the spiral gear is in operative position. The toothed key 29 is maintained in such position as shown in Fig. 23 by means of a retaining block 30 which lies within a notch in the hub of said spiral gear—see Fig. 22, and is maintained within said notch or recess by means of a leaf spring 31. In order to release the toothed key 29 from the rack 27 on the shaft and thus permit the spiral gear to be shifted to the desired position, the retaining block 30 is drawn out against the pressure of the spring 31 to a sufficient extent to permit the rack 27 to pass under said block thereby disengaging the teeth of the key 29. This spiral gear may be then shifted to the desired position and again interlocked with the rack 27 by rotating said gear to the proper position to reëngage the rack and the key after which the retaining block 30 is allowed to enter the recess as before. The spiral gear or gears 28 engage a similar gear 44 on an intermediate gear shaft 41 which has bearings in journals 42 and 43 extending from the side plates 34. Geared to the shaft 41 are any number of drills 47 through means of bevel pinions 39, one of which is shown in Fig. 20, said pinion 39 engaging a similar pinion 40 fixed to the upper end of the driving spindle 38 of the drill. The bevel pinions 39 are splined to the shaft 41 which is shown to be provided

with spline 45. The driving spindle 38 is journaled in a bearing 35 which is fastened between the edges of the side plates 34 by means of a lower jam nut 37 and a washer 36—see Fig. 21: The lower end of the driving spindle 38 is enlarged and recessed as at 46 to receive the upper end of the drill 47, and the lower threaded end 50 of said driving spindle receives a clutch nut 48 which incloses a collet 49 which grips the shank of the drill and maintains it rigidly in the socket of the driving spindle. Placed between the enlarged portion 50 of the driving spindle and the lower end of the bearing 35 is an anti-friction bearing 51. The power is introduced to the machine through the turret-head, being conveyed to the main driving pulley 52 on shaft 10.

Referring to Figs. 28 and 29, the drill bar 280 replaces the drill rail 34 shown in Fig. 20 on the turret-head and is attachable to the turret-head in the same manner as the drill rails 34. These drill bars 280 are utilized in place of the drill rails 34 whenever it is desired to bring the drills 47 closer together than is possible when using the drill rails 34, and owing to the further fact, that a greater number of drills may be driven from the drill bar. The worm gear 44 shown in Fig. 20 is the same as the worm gear 44ª shown in Figs. 28 and 29, but instead of being employed upon the splined shaft 41, is rigidly mounted upon a short shaft 41ª that has a bearing 43ª and 281, said bearings 43ª and 281 projecting from a side of the drill bar 280. On the end of the shaft 41ª opposite the worm gear 44ª there is a bevel gear 40ª which engages a similar gear 40ᵇ upon a shaft journaled in the drill bar; driven on either side of this main driving gear 40ᵇ through pinions 282 are a series of drill driving spindles 283 upon which said pinions 282 are mounted and which spindles are mounted in the drill bar sides and receive the drills 47. A suitable number of idlers 284 are employed to transmit movement to the pinions 282 of the outlying drill driving spindles. In Fig. 1, one of these drill bars appears on the turret-head.

Turret-head indexing mechanism.—The rotary indexing plate 53 of the turret-head has a series of peripheral locking recesses 54 and a fixed connection with the hub 8ª of the turret-frame 8. When the turret-head is indexed, it is held in position by the shot bolt 56 entering a given recess 54. This shot bolt will be referred to further in connection with its coöperative devices. The indexing plate is rotated by means of a worm wheel 97 fixed thereto and engaging a worm 93 on shaft 90 journaled in bearings 91—92 and 96. On the lower end of the shaft 90 is a spiral gear 89 which drives said shaft and is itself driven from a spiral gear 83 on shaft 84 having bearings 85 in the cross frame 4. A clutch member 82 is fixed to the spiral gear 83, and a cooperating clutch member 81 is splined upon shaft 84, the latter shaft receiving movement from a bevel gear 86 thereon which engages a bevel gear 87 on shaft 88, the latter shaft being journaled in the side frames 3 and 7. Upon the shaft 88 there is a sliding clutch member 105ª which is adapted to engage with a clutch member 104 fixed to a bevel gear 103, which is loose upon the shaft 88. Engaging the bevel gear 103 is a similar gear 102 on shaft 101 and moving with a pulley 100 on shaft 101 journaled in bearings in the side frames 7. The pulley 100 is connected to pulley 98 on the main driving shaft 10 by a belt 99. It will be understood that when the clutch members 105ª and 104, Fig. 5, and clutch members 81 and 82, Fig. 10, are brought in operative relation, the turret-head will be rotated, and the clutch members 105ª and 104 are brought in operative relation when the machine is started by means hereinafter described. When the shot bolt 56 is pulled out of the notches 54 in the indexing plate, the clutch members 81 and 82 are brought into operative relation. The shot bolt 56 is on the upper end of rod 57 having a turn buckle 60 for adjustment, and a spring 58 exerting a normal upward pressure on the shot bolt, said shot bolt rod moving in upper and lower guides 59. The shot bolt is released from the indexing plate by the descending platen and the following mechanism: Mounted below the lower platen 106 is an arm 71 having a tripping block 72 adjustable by means of screw 73. The block 72 in descending, engages the pivotal trip piece 70 on the arm 69. The trip piece 69 is rigid on rock shaft 68, the latter having bearings in cross frames 4 and 5. Upon the rock shaft 68 there is a segment gear 67 which engages a rack 66 on the front portion of the shot bolt. Simultaneously with the rocking of the shaft 68, the shot bolt 56 is released from engagement with the indexing plate and the clutch members 81 and 82—Fig. 10, are thrown in gear, and movement is imparted to the turret-head.

Extending from the lower portion of the shot bolt are brackets 62 and 63 having adjustable screws 64 and 65—Fig. 7. Lying between these adjusting screws is the clutch lever 74 and rock shaft 75. Upon the other end of the rock shaft 75 is the clutch fork 80 which engages the movable clutch member 81, the other clutch member 82 being fixed to the spiral gear 83 and both of which run loosely on the shaft when free from engagement with the clutch member 81. It will therefore be seen that when the shot bolt 57 descends, the screw 64 will engage the clutch-shifting lever 74 and will cause

the clutch members 81 and 82 to engage and will thus cause the spiral gear 83 to rotate, thereby rotating the turret-head through, as before stated, the spiral gear 89. When the shot bolt enters one of the locking recesses 54 in the turret head through the agency of the spring 58, the lower screw 65 will engage the lever 74 thereby rocking the shaft 75 in the reverse direction to disengage the clutch members 81 and 82. When these operations take place, the turret-head will start and stop suddenly; this renders necessary a cushioning device in the form of a coil spring 94 which surrounds the upper portion of the worm shaft 90 and is inclosed between a washer 95 rigid on the shaft 90 and the bearing 96. The shaft 90 is splined in lower end to permit free movement of gear 89 upon shaft 90. The worm gear 89 is pinned to the shaft 90 in order to permit of the slight movement of the shaft 90 due to the aforesaid causes. It is necessary that the rock shaft 75 be held in either position temporarily; that is to say, when the clutch members 81 and 82 are in engagement, the shaft 75 must be held, and likewise when the clutch members are out of engagement. This retaining device is illustrated in Figs. 7 and 9, and consists of a rigid retainer 78 on the rock shaft 75 and terminating in a pointed end, and a spring-controlled retainer 77 of similar shape and slidably mounted in a boss 76 projecting from the cross frame 4. On one side of the spring-controlled retainer there is a pin 79 to prevent it from rotating in the boss. As these retainers are shown in Fig. 9, the points are out of alinement, or one is slightly below the other, and in this position, the clutch members 81 and 82 are out of engagement. When the clutch members are in engagement, the point of retainer 78 will lie above the point of retainer 77. In order to index the turret-head to different positions and not consecutively, a desired number of the peripheral recesses 54 in the indexing plate 53 are provided; these are closed by the insertion of removable plugs 55, thus permitting the shot bolt to pass over such closed recesses until it reaches the desired recess. In indexing the turret-head consecutively, all of these recesses remain open.

Platen mechanism.—This mechanism is more particularly illustrated in Figs. 1—3—6 and 24. The upper and lower members 105 and 106 of the platen or work-table, have dove-tail connections allowing the upper member 105 to have independent horizontal movement. These platen members are supported upon a vertically-sliding frame 107 which moves in side frames 2 and 3; mounted upon said sliding frame 107 is a roller 108 which rides upon the periphery of an elongated cam 109 which is fixed to a shaft 110 journaled in the cross frames 4 and 5. Upon the shaft 110 there is a worm wheel 111 which engages a worm 112 on shaft 113 journaled in the side frames 2—3 and 7. The platen-carrying frame 107 has a variable rising movement to accommodate the different speeds of the drills and the metal to be worked upon. This variable movement of the platen is obtained through the following change-speed mechanism.

Change-speed mechanism for platen.—The shaft 88 has upon it three differential gear wheels 124, 119 and 115; the gear wheel 122 meshes with 124, said wheel 122 being loose upon the worm shaft 113, and through these gears 122 and 124 the maximum speed is obtained for elevating the platen; the gear wheel 122 has on one side a clutch member 123 which is adapted to be placed in and out of engagement with a clutch member 121 splined on shaft 113. The intermediate speed is obtained through the gear wheel 119 which is of decreased diameter as compared to the wheel 124, said gear wheel 119 engaging with a gear wheel 118 loose upon shaft 113 and having on one side thereof a clutch member 120, said clutch member 120 being adapted to engage the other clutch 121; the clutch 121 is adapted to be thrown in either direction by a clutch lever 126 which will be again referred to. The minimum speed is obtained through the smaller gear wheel 115 on shaft 88 which engages with the larger spur wheel 114 which is also loose upon shaft 113; this last-named gear, to-wit—114 carries a ratchet pawl 117 which engages a ratchet wheel 116 fixed to the shaft 113 and constituting the moving engagement between the said shaft and the gear wheel 114.

The above-specified change-speed gearing is substantially the same as is shown and described in Letters Patent hereinbefore referred to.

Timing mechanism for platen.—The clutch-shifting lever 136 is fulcrumed at 133 upon a bracket 135 and is normally held in position by spring 263 to cause the clutch 121 to engage the clutch 123 on the high speed gearing. Pivoted upon the same shaft 133 which forms, as before stated, the fulcrum of the shifting lever, is a rocker arm 132, one end of which engages a roller 134 which rides against the peripheral surfaces of the timing wheel 129 on shaft 128, and the other end of said rocker arm having a hook 137 which engages the side pieces 131 on said timing wheel 129.

131 designates a series of trip pieces removably attached to the side of the rim of the timing wheel 129; these trip pieces are arranged at suitable points to be engaged by the hook end 137 of the rocker arm 132; the object of said trip pieces is to trip the rocker arm to rock the shaft 133 to actuate the shifting lever 136 through the engage-

ment of the other end of the rocker arm 132 with the roll stud 134 which is mounted upon an extended portion 136 of said shifting lever. It will be undestood that the rocker arm 132 is loosely mounted upon the shifting lever shaft 133.

As shown in Fig. 2, the clutch 121 is shown in engagement with the high-speed gearing, such engagement being effected through the spiral spring 263, one end of which is connected to the extended portion of the shifting lever 136, and the other end of which is connected to an upright lever 262. As the gearing is shown in Fig. 5, the clutch is out of engagement with either of the clutch members 120 and 123, and the gearing is in the low speed condition; to bring about this condition, the rocker arm 132 is tripped by one of the trip pieces 131, and to move said clutch devices to the intermediate speed, the trip piece 131ª which is shown to have a higher periphery than the trip pieces 131, is in a position to engage the nose 137 of the rocker arm. The trip pieces 131 and 131ª may have any desired length or depth and may be placed at any desired point to effect the above results.

Arranged around the periphery of the timing wheel are a series of adjustable stop pieces 130, the object and purpose of which are to prevent the clutch 121 from being moved from one extreme position to the other, when it is only desired to move said clutch from one extreme position to its intermediate position, for example, from a connection with clutch member 123 on the high speed gear to its intermediate position, at which time the low-speed gearing is in operation. This shifting of the clutch takes place when the nose 137 engages one of the trip pieces 131. The clutch lever 136 is thus controlled by the roller 134 engaging one of the peripheral pieces 130. It will be borne in mind that said clutch lever is so controlled by the peripheral pieces 130 when the clutch is thrown from the high speed gear 122 to the intermediate position of said clutch, at which time, the low speed gear 114 is driven through ratchet pawl 117, the ratchet wheel 116 and upper gear 115 on shaft 88 and lower gear 114 on shaft 113. When the clutch 121 is moved from engagement with clutch 120 on the intermediate speed gear 118, to the intermediate position of said clutch 121, said clutch 121 is prevented from moving too far by the nose 137 moving off of the trip piece 131ª onto a trip piece 131. It will be seen that the periphery of the trip piece 131ª is higher than the periphery of the trip pieces 131, and it is due to this variation that the clutch is moved from the high speed position shown in Fig. 2, to the intermediate position (not shown.) As the clutch is shown in Fig. 5, it is out of engagement and the machine is operating under low speed due to the low speed gear 114 being driven directly from the shaft 113 through the ratchet pawl 117 and the ratchet wheel 116. The trip and stop pieces 131—131ª and 130 may be of any sizes and located at any position to accommodate the desired speeds in the rise of the platen.

It will be understood that when the platen or work-table descends, it always moves under the high speed gear, and if it is desired to again elevate said platen under the same speed, the clutch remains in gear with the high speed gear, but if it is desired to elevate the platen under a slower speed, the clutch disengages from said high speed gear and is shifted for the next desired speed through the engagement of the nose 137 with one of the trip pieces 131 or 131ª, and after the platen has been elevated to its limit, the clutch reëngages the high speed gear to lower it. It will be borne in mind that through the above-described timing mechanism, the platen cam 109 hereinbefore referred to, is timed to elevate and lower the platen. The shaft 110 of the cam 109 being the shaft upon which is mounted the worm gear 111 which is driven from the change-speed shaft 113—see Figs. 5 and 6. The timing wheel 129 is on shaft 128 which has its bearings in side frames 3; this shaft is driven from gear wheel 127 which receives its movement from the worm wheel 111 through the intermediate gears 125 and 126.

Platen-indexing mechanism.—This mechanism is illustrated in Figs. 1—3—24 and 25. As hereinbefore stated, the upper member 105 of the platen has a sliding connection with the lower member as shown in Fig. 3, and is also provided with a rack 146 on the lower side, and a series of locking recesses 149; engaging the rack is a pinion 145 on shaft 147 by means of which the indexing movements are given to the platen either through the hand wheel 148 which is fixed to the shaft of said gear wheel, or the indexing movement is imparted to said platen automatically through the segment gear 143 extending from shaft 110. A pin 144 fixed to the side frame 2 maintains said segment gear in an operative position, said gear being loose upon the shaft 110 and therefore subject to friction due to the moving shaft which always has a tendency to place the segment gear in the position shown in Fig. 24; this segment gear is rocked upon its fulcrum 110 by means of a series of cams 140 engaging a roller 141 and a projection 142 of segment gear 143; the cams 140 are adjustably mounted in grooves 139 on the face of a disk 138, the latter disk being rigidly mounted on the shaft 128. It will be borne in mind that the shaft 128 also carries the timing wheel and is driven from shaft 110 as shown in Fig. 5. It will be seen from Fig. 1, that the disk 138 has six radial

grooves which may accommodate a similar number of cams 140 when it is necessary to index the platen for each side of the turret-head. As shown in Fig. 1, there are only three of such cams so that the platen is indexed three times while the turret-head may be indexed six times. Projecting rigidly from the lower platen 106 is a housing 151 which contains a locking bolt 150 adapted to enter any of the locking notches 149 under the pressure of a spring 152 seated in said housing below the bolt. Projecting from the rear side of the locking bolt 150 is a pin 163 which is in a position to be engaged by the cam 162 on the extreme end of the segment arm 143; this engagement takes place immediately prior to the engagement of the moving segment arm with the pinion 145 in order to disengage the locking bolt from the platen prior to the movement of the pinion 145. At the limit of the indexing operation of the segment arm 143, the locking bolt 150 enters a locking notch 149; at this time, the platen rises, the locking bar enters a locking recess therein to hold it at its indexed position, and the gear 145 is lifted out of engagement with the teeth of segment 143 by the raising of the platen, and the roller 141 is released by a cam 140 on the disk 138. The locking bolt 150 is also connected to a hand lever 153 by means of a pin 154 which enters an elongated opening in the housing 151 and engages said locking bolt, so that the bolt may also be manipulated by hand to unlock and lock the platen; the hand lever 153 is fulcrumed at 153[a] and has an extension 155 forming a bell crank lever upon the lower end of which is pivoted a lever 156, the latter lever is connected at its forward end through an adjustable screy 161 to a depending link 158 which carries upon its lower end a roller 159 and is pivoted at its upper end to the lower member of the platen 106; engaging the roller 159 is a cam or tapering surface of a block 157 forming an inclined plane, said block being fixed to a frame 160 on the side frame 3, and is therefore stationary while the roller travels against the inclined surface, and in connection with the thrust rod 156, the levers 155, and 153, maintains the locking bolt 150 in any of the locking recesses while the platen is ascending; this mechanism provides more positive means for retaining the locking bolt in locked position and while the platen is rising, and affords means for this purpose in addition to the spring 152.

Horizontal drill-driving mechanism.—The above mechanism is illustrated on Sheets 1—2—3—8—9—10—11—12 and 13. On the main driving shaft 10 there is a gear wheel 164 which drives a similar wheel 165 mounted upon a boss 166 on the journal 6. Moving with the wheel 165 is a bevel gear 167 which drives a similar gear 168 on shaft 169 upon the lower end of which is a bevel gear 170 engaging a similar gear 171 on shaft 172. The shaft 172 drives the rear horizontal drills in the drill box 182. The bevel gear 170 is splined to the shaft 169 and the gear 173 is splined to the shaft 172. In mesh with the gear 173 is a transmission gear 174 through which movement is conveyed to a gear wheel 175 on lower horizontal shaft 176; the latter shaft extends entirely through the machine and at its forward end is provided with a gear 235 which drives the front horizontal drills to be hereinafter described in connection with the front horizontal drill mechanism. Midway of the shaft 176 is a gear box 180—see Fig. 19, which forms a bearing for the shaft 176 at that point. Mounted within said box is a spiral gear 179 which engages a similar gear 178 splined on shaft 177. The box 180 also provides a bearing for the shaft 177 which drives the side horizontal drills to be hereinafter described.

Rear horizontal drill mechanism.—The above mechanism is illustrated on Sheets 12—13 and 14. Projecting from the lower platen 106 is a frame 181 which supports the rear drill box 182, through the intervening slide 183. Slidingly mounted upon the frame 181 is a slide 183 which supports said drill box, the box being rigidly attached to said slide, and the latter being movable in guide ways 184 in the frame 181. Upon the lower side of the horizontal slide 183 is a rack 185 which is engaged by a segment gear 186 on rock shaft 187 supported on brackets 188. Also on shaft 187 is another segment gear 189 which is in mesh with a vertical rack 190 on a slide 191, said slide 191 being movable in guide ways 192 on the side frame 3. The rear horizontal drill box is fed inwardly to the work by the upward movement of the platen 105. The platen moves upwardly six times while the drill box has one or more movements to its feeding position, it therefore becomes necessary to provide means to regulate these movements of the drill box at the proper period during the movements of the platen. It will be seen that if the slide 191 is kept stationary as the platen rises, the gear 189 will roll on rack 190, thereby rocking shaft 187 and the gear 186. As the gear 186 is in mesh with the rack 185 on the slide 183, the drill box 182 will move inwardly at the rise of the platen as before stated. But as it is desired for the drill box 182 to be fed inwardly one or more times to the platen rising six times, it becomes necessary to provide means to release the vertical slide 191 so that the said slide will rise with the platen. As this slide 191 rises with the platen, the gear 189 will not roll on the rack

190, consequently, the drill box 182 will not be fed inwardly. When the slide 191 is released, the friction of the various parts is sufficient to carry said slide upwardly at such times when the platen is moving upwardly and the drill box is not fed to its work.

As the slide 191 is shown in Fig. 12, it is subject to be moved upwardly with the platen and the gears 189 and 186 are not effective for actuating the drill box, but when the slide 191 is locked by means of either of the pins 196 and 197, the upward movement of the slide is arrested and the drill box is fed in owing to the rack 190 actuating the gear 186 through the segment gear 189. At this period, it will be understood that the rack 190 is stationary and the segment gear 189 is moved owing to the bracket 181 being moved upwardly with the platen. The pins 196 and 197 are moved to positions to lock the slide 191 during the indexing movement of the platen 105 and according to the extent of such movement, for example, 200 designates a cam which is located at the desired point on the surface of the horizontally-movable platen 105, said cam being adjustable to the desired position acording to the rise to be given the platen, for example, the shot or rise of the platen is first determined and then the cam 200 is placed in the proper position so that when it is indexed by the horizontal movement, it will engage either of the locking pins 196 or 197 according to the extent of horizontal movement to be given to the horizontal slide 183. In other words, one of the pins provides for the locking of the slide 191 during the entire rise of the platen, for example, the left hand pin 196. During this period of engagement of the pin 196 and the entire rise of the platen, the drill box is given its greatest feeding movement. The pin 197 engages the slide 191 to lock it to cause the rack 190 to actuate the segment gears 189 and 186 only part of the extent of the rising platen and to thus feed the drill box 182 to the desired extent and which feeding operation takes place after the pin 197 has so engaged the slide 191 to lock it. From Fig. 13, it will be seen that the slide 191 has an elongated slot 195 in which the pin 197 projects, and it will be seen that the slide 191 is moved upward to the limit of said slot before the pin 197 arrests its movement. During the remainder of the rise of the platen the drill box is fed into the work. The pins 196 and 197 are inserted in the orifices 194 and 195 in the slide 191 by the cam 200 on the platen being moved against said pins in the indexing movement of the platen, and in the rise of the platen, the said cam maintains such locking engagement between either of said pins and the slide 191 by riding against the extended arm 199.

Referring more particularly to the spindles of the rear drill box, these are driven from a master gear 207 in drill box 182 and mounted on shaft 172—see Fig. 3. In mesh with this master gear are idlers 205 lying within the drill box and engaging the gears 204 on the drill spindles 202. On the inner ends of the drill spindles are the chucks 203 that connect the drills proper to their respective spindles.

It will be understood that the drills may be of any desired sizes and located at any desirable points in the boxes, and this is true of all the horizontal drills.

The drill box 182 is provided with a cap 206 inclosing the top thereof.

Front horizontal drill mechanism.—The front horizontal drill box 209 is substantially the same in construction as the rear box just described and is operated substantially in the same manner as the rear drill box with some variations which will now be described.

Instead of employing additional segment gear 186 to actuate the rack of the front drill box slide 210, a crank 214 is connected to the shaft 215 which is journaled in brackets 216. The front drill box slide 210 is supported on a frame 208 extending from the lower platen and provided with guide ways 211. The crank arm 214 is attached to a connecting rod 213, and the latter is connected to an arm 212 extending from the slide 210 and thus the necessary horizontal movement of the front drill box slide 210 is imparted to the shaft 215 through the segment gear 217, the rack 218, and the slide 219 in the guide way 220. Both slides 191 and 219 of the rear and front drill boxes are maintained in their inclosing guide frames 192 and 220 by means of retaining plates 193 and 221 attached to the inner sides of said guide frames.

201 and 227 designate supporting brackets which are attached to the rear sides of the guide frames 192 and 220 and serve to limit the downward movement of the slides 191 and 219. The front drill box side frame 219 is provided with a single locking pin 223 and extension 225 which is similarly operated upon by an adjustable cam 226 in the upper face of the platen 205; the slide 219 has a single aperture 222 to receive said pin, and the pin, together with the pins 196 and 197 are provided with springs 198 and 224 to normally hold them out of engagement with the apertures in said slides 191 and 219.

Resting on the slide 210 is the front horizontal drill box 209 which supports drill spindles 228 having driving pinions 229 and intermediate idlers 232; these spindles are driven from a master gear 230 on shaft 231 geared to the shaft 176 by means of gear

wheels 233—234 and 235, the latter gears will be again referred to in connection with the clutch members 256 and 257 shown in Fig. 18, and adapted to throw in and out all of the horizontal drills.

Side horizontal drill mechanism.—The above mechanism is shown on Sheets 1 and 12 and the mechanism of one is the same as that of the other. In Figs. 16 and 17, the left hand side drill box and its accompanying mechanism is illustrated, but it must be understood that the right hand side drill box and its accompanying mechanism is the same in all substantial particulars. On the upper platen 105 there is mounted a fixed guide 238 which supports a horizontal slide 237 to which the drill box 236 is rigidly connected. Also supported on the slide 237 is a horizontal rack 239 which is designed to engage a pinion 242, the shaft 241 of which is mounted in brackets 240 projecting from the base 238; also projecting vertically from the base 238 is a guide or housing 245 open on its inner side and loosely supporting a vertical rack 244 which engages a pinion 243 at the other end of the shaft 241. It will be seen that in the horizontal or indexing movements of the platen 105, the rack 244 as well as the other parts attached to the base 238 will receive similar movement, or in other words, all the mechanism shown in Fig. 17 with the exception of the frame 3 will be similarly moved with the platen, but neither of the pinions 242 or 243 will be actuated by their respective racks 239 and 244 during such horizontal movement of the platen; in such horizontal movement of the platen, however, the upright rack 244 will be moved below a projection 246 on the stationary frame 3 and above a lower projection 247 on said stationary frame and shown in dotted lines in Fig. 17, and in full lines in Fig. 1. It will thus be seen that when the platen is indexed, the rack 244 will lie between these projections 246 and 247. When the platen ascends from this indexed position, the rack 244 is arrested by contact with the projection 246 and is thus caused to actuate the pinion 243 to rotate the shaft 241, the pinion 242 and the horizontal rack 239 to feed the drill box to its work. The drill spindles 248 are journaled in the sides of the box 236 and have driving gears 249 and idlers 250 which receive movement from the master gear 251 on shaft 252. 253 are oil slots or openings in the top of the drill box to feed lubricating substance through oil holes 254 to the spindles. It will be borne in mind that it is only during the shot of the platen in which the drills are fed that they rotate; this is true of all of the horizontal drills.

Clutch mechanism for controlling the horizontal drill boxes.—The above mechanism is shown in Fig. 18, and it will be understood that it is common to all of the horizontal drill boxes. The shaft 252 upon which one of the master gears is mounted, has a bearing in the hub of the gear wheel 233, which in turn, has a bearing in the bracket 255 which is secured to the upper member 105 of the platen. The gear 233 is loose upon said shaft and transmits movement to said shaft through clutches 256 and 257, the former of which is on the face of said gear 233 and the latter clutch member is splined to said shaft and is controlled by a spring 259 on said shaft on one side, and a shoulder 258 on said shaft on the other side of said clutch member 257. These clutch members and spring are inclosed in a cylindrical housing 260 which is secured to the gear 233, and consequently, rotates therewith. The shaft 252, it will be borne in mind has a longitudinal movement due to the feeding of the drill box through the mechanism previously described and shown in Figs. 14—15—16 and 17; at such times the clutch members 256 and 257 engage, and the shaft 252 is rotated from the gear 235 on shaft 177, and the intermediate gear 234; these latter gear wheels 234 and 235 are inclosed within a housing 261 and are subjected to the necessary lubrication therein. As hereinbefore stated, the shaft 177 receives movement from shaft 176 through spiral gears 178 and 179—Fig. 19. In the front horizontal drills the shaft 231 is similar in function to the shaft 252 of the side horizontal drills, and shaft 177 is similar in function to shafts 252 and 176, and likewise shaft 172 is similar in function to the shafts above mentioned. The bevel gears 170 and 171 introduce power to all of the above-mentioned shafts, driving the rear spindles of the drills directly through shaft 172 and the other horizontal drill spindles through the transmission gears 173—174 and 175—see Fig. 3.

Starting and stopping mechanism of the platen.—As hereinbefore stated, the differential feed movements are given the platen through the mechanism shown in Fig. 5, which has hereinbefore been fully described; said mechanism having the shaft 88 provided with the clutch members 104 and 105[a] through which the power is introduced and cut off. As the mechanism is shown in Fig. 5, the power is cut off by the separation of the clutch members 104 and 105[a], the latter of which is movable by being connected to the clutch lever 262 having its fulcrum on the frame and pivotally connected to a clutch locking bar 264, the inner end of which has a shoulder 265 which is adapted to engage a projection 266 on the frame 7 when the clutch is thrown in; when the clutch is thrown out as in Fig. 5, the right hand notch or shoulder on said bar 264 will

engage said projection. Projecting from a side of the bar 264, is a pin 267 which enters a cam slot in the crank 268; the said crank being fixed on a short shaft 269 to which a second crank 271 is likewise connected and also a hand-operating lever 270. Linked to the crank 271 is a thrust rod 272, the free end 279 of which is suitably supported on a portion of the frame 3. Pivoted at 273 to the thrust rod 272 is a stop and release lever 276 having its extended end 274 adapted to be moved in and out of the path of a stop lug 278 on the disk 277 on shaft 128. When the lever 276 is engaged by the lug as shown in Fig. 5, the clutch members 104 and 105[a] are released as shown; the effect of the engagement of the lug with the end of the lever 276 being to move the thrust rod 272 to rock the shaft 269 and to elevate the clutch locking bar 264 through the pin and slot 267 and 268 engagement, and to free the end of said bar 264 from the projection 266, at which time, the spring 263 pulls the clutch lever 262 and thereby causes a disengagement of the clutches to cut off the power for the feeding mechanism. To throw in the power by connecting the clutches, the lever 276 is elevated to move the end thereof out of the path of the lug 278 and the lever 270 is lowered to reëngage the locking bar 264 with the projection 266. A spring 275 holds the end 274 of the lever 276 in a position to be engaged by the lug 278.

It will be understood that the horizontal drill boxes are placed in their respective positions when the machine is assembled and shipped from the factory, and all adjustments are made. When so assembled and adjusted, the machine is operated briefly as follows: The power is introduced from the line shaft (not shown) to the turret-head shaft 10 to rotate the turret-head intermittently when indexed during the operations of the machine, and also to drive the drills and all of other moving parts of the machine. The platen rises initially to present the work to the turret-head and the horizontal drill boxes; in descending, the platen sets in motion the turret-head-indexing mechanism, and releases the shot bolt mechanism to unlock the turret-head preparatory to the next ascension of the platen in the locking operation of the shot bolt.

We claim:

1. In a drilling machine, a turret-head, a platen or feed table, and means interposed between the turret-head and the feed table whereby the turret-head is intermittently indexed by the movement of the feed table in retreating, and means for actuating said feed table.

2. In a drilling machine, a turret-head, a platen, means for indexing said turret-head, means for locking the turret-head when indexed, said indexing means and locking means arranged to be actuated by the retreating platen, and means for actuating said platen.

3. In a drilling machine, a platen, a drill box on said platen, means for feeding the drill box in a direction parallel with the platen adapted to be actuated by the upward movement of the platen, means for driving the drills in the box, and means for raising and lowering the platen.

4. In a drilling machine, a turret-head, a platen, a horizontal drill box on said platen, means arranged to be initially actuated by the lowering of the platen and through which the turret-head is indexed, means for driving the indexed drills of the turret-head, means for feeding said drill box arranged to be actuated by the upward movement of the platen, and means for driving the drills of said drill box.

5. In a drilling machine, a turret-head, means to index said turret-head, a shot bolt to lock said turret-head when indexed, a vertically-movable platen, means adapted to be actuated by said platen in descending to lower the shot bolt, and means adapted to be actuated by the shot bolt in descending to set in operation the indexing mechanism of the turret-head.

6. In a drilling machine, a turret-head, means for indexing said turret-head, a vertically-movable platen, a shot bolt to lock the turret-head in its indexed position, means adapted to be actuated by the platen when descending to disengage the shot bolt and to lower it, clutch mechanism connected to operate the indexing mechanism, and means on the shot bolt whereby said clutch mechanism is controlled and enabling the indexing operations of the turret-head to take place when the platen is descending.

7. A drilling machine comprising a frame, a platen mounted to move in two directions at an angle to each other, a drill box carried therewith and movable parallel with the face thereof, a guide on the frame, a slide movable therein parallel with one direction of motion of the platen, a lock for the slide, said lock being so disposed as to coöperate with the platen in certain positions of its lateral motion with respect to the slide to lock the slide to the guide, and a connection between the slide and the drill box adapted to be operated by the relative movement of the slide with respect to the platen to move the drill box parallel with the face of the platen.

8. In a drilling machine, a rotatable turret-head having a multiplicity of sides, a drill bar adapted to be mounted on any side of said turret-head, a drill spindle journal adjustably mounted on said drill bar, a drill spindle mounted in said journal, a

splined shaft mounted on the drill bar and lying parallel thereto, means to transmit motion from said splined shaft to said drill spindle, and means to transmit movement to said splined shaft.

9. In a drilling machine, a turret-head, a platen, a stop-motion mechanism comprising an actuating shaft, a clutch on said shaft, means driven from said shaft to index the turret-head, means driven from said shaft to index the platen, a rotating disk driven from said shaft, and means interposed between said clutch and said disk for actuating the clutch to stop the turret-head and platen-indexing means.

10. In a drilling machine, a turret-head, a platen, a stop-motion mechanism comprising an actuating shaft, a clutch on said shaft, means driven from said shaft to index the turret-head, means driven from said shaft to index the platen, means whereby the clutch may be thrown to actuate the turret-head and platen-indexing means, a disk driven from said shaft, a trip on said disk, a lever adapted to be engaged by said trip, and connecting mechanism between said lever and said clutch, and by means of which said lever is adapted to be disengaged from the trip-piece prior to the actuation of the clutch-throwing-in mechanism.

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

HARRY E. TEMPLE.
OLIVER L. DOSCH.

Witnesses to Harry E. Temple's signature:

GEORGE LIMOUZE,
RICHD. T. ATKIN.

Witnesses to Oliver L. Dosch's signature:

R. J. MCCARTY,
EDWARD BUSCH.