(No Model.) 6 Sheets—Sheet 1.

F. H. RICHARDS.

DRILLING MACHINE.

No. 426,571. Patented Apr. 29, 1890.

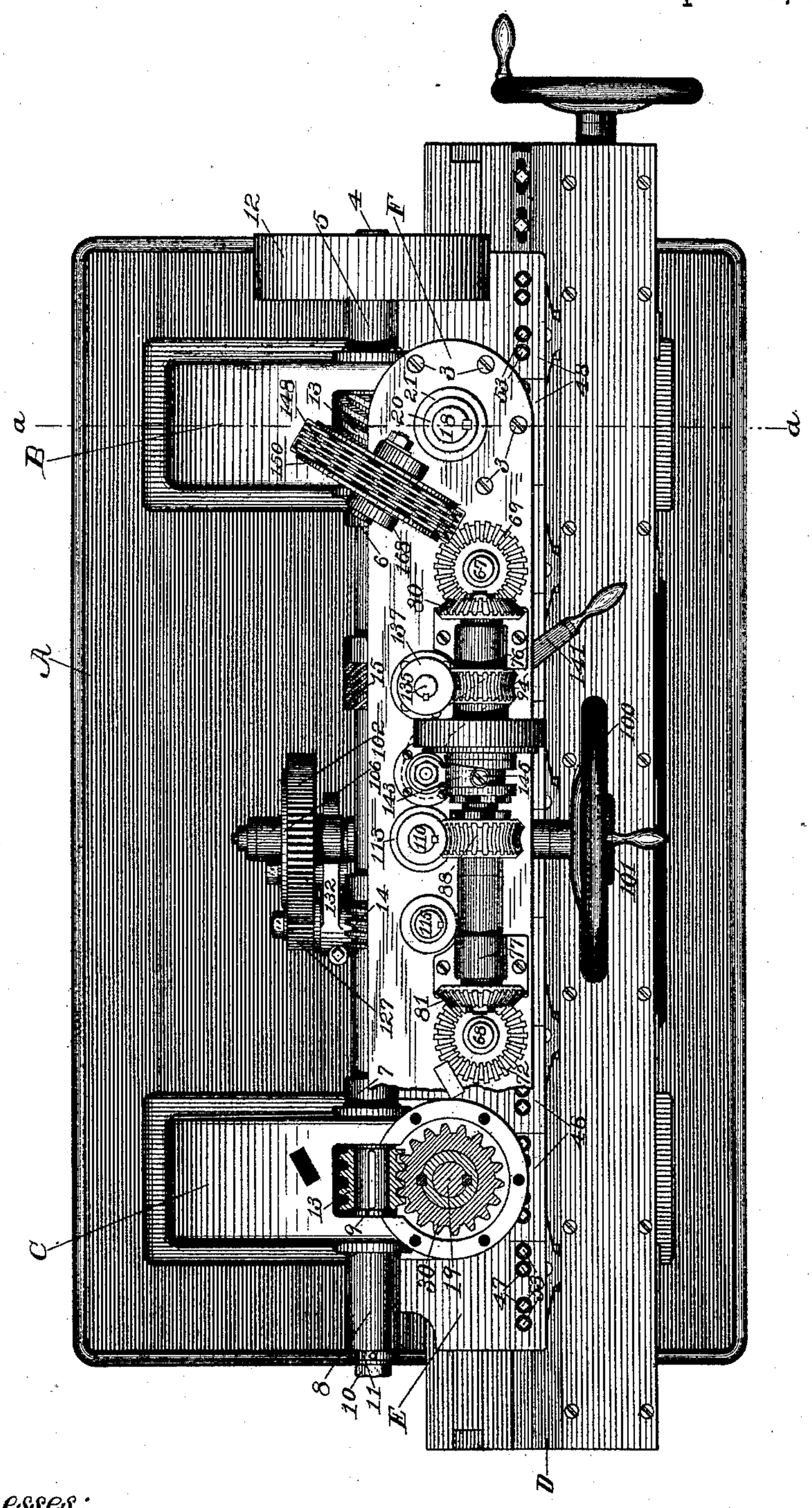

Fig. 1.

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L. C. Heermans.

Inventor:
Francis H. Richards

(No Model.)

6 Sheets—Sheet 2.

F. H. RICHARDS.

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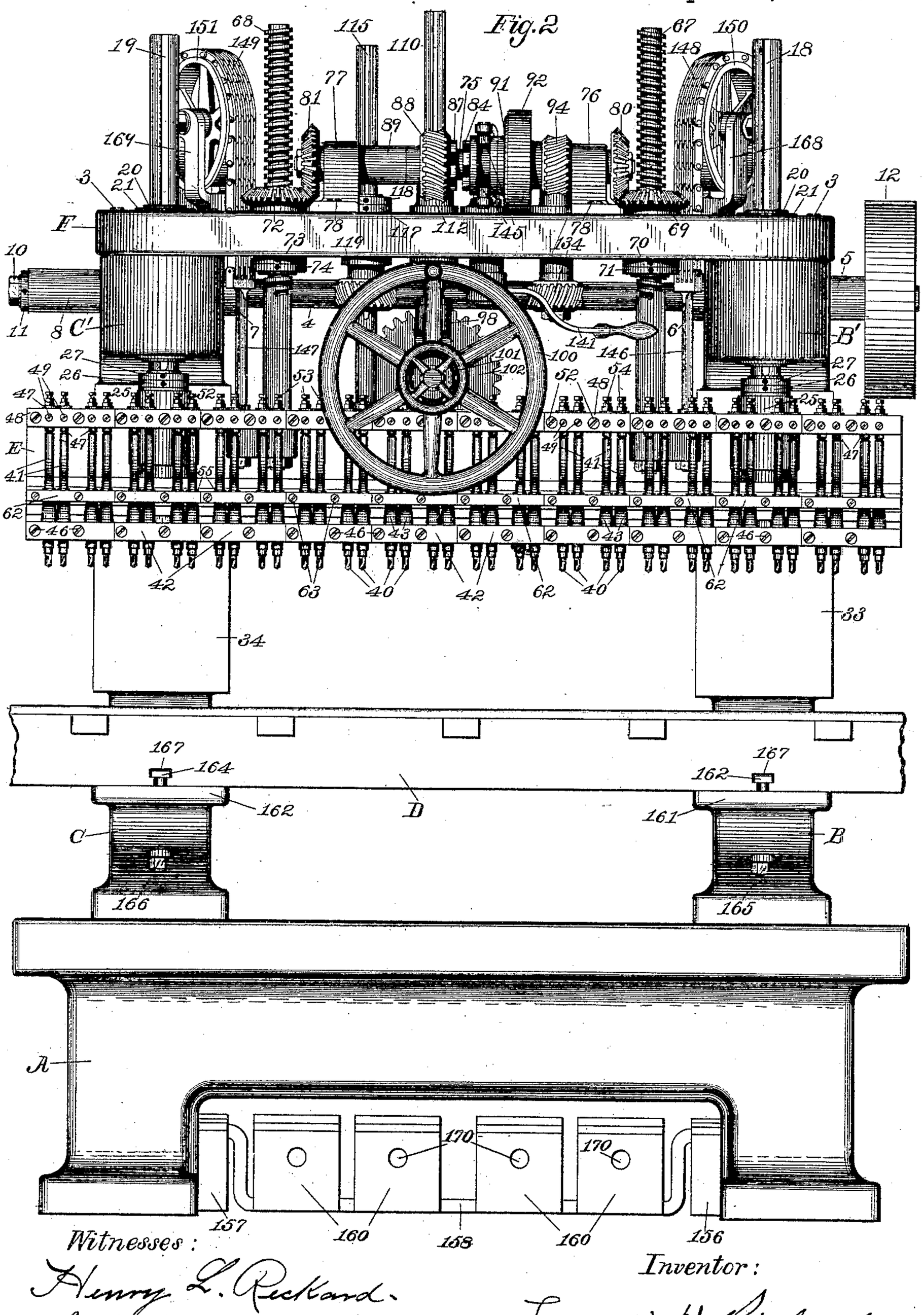
Fig. 2



Witnesses:

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(No Model.)

6 Sheets—Sheet 3.

F. H. RICHARDS.

DRILLING MACHINE.

No. 426,571. Patented Apr. 29, 1890.

Fig. 3

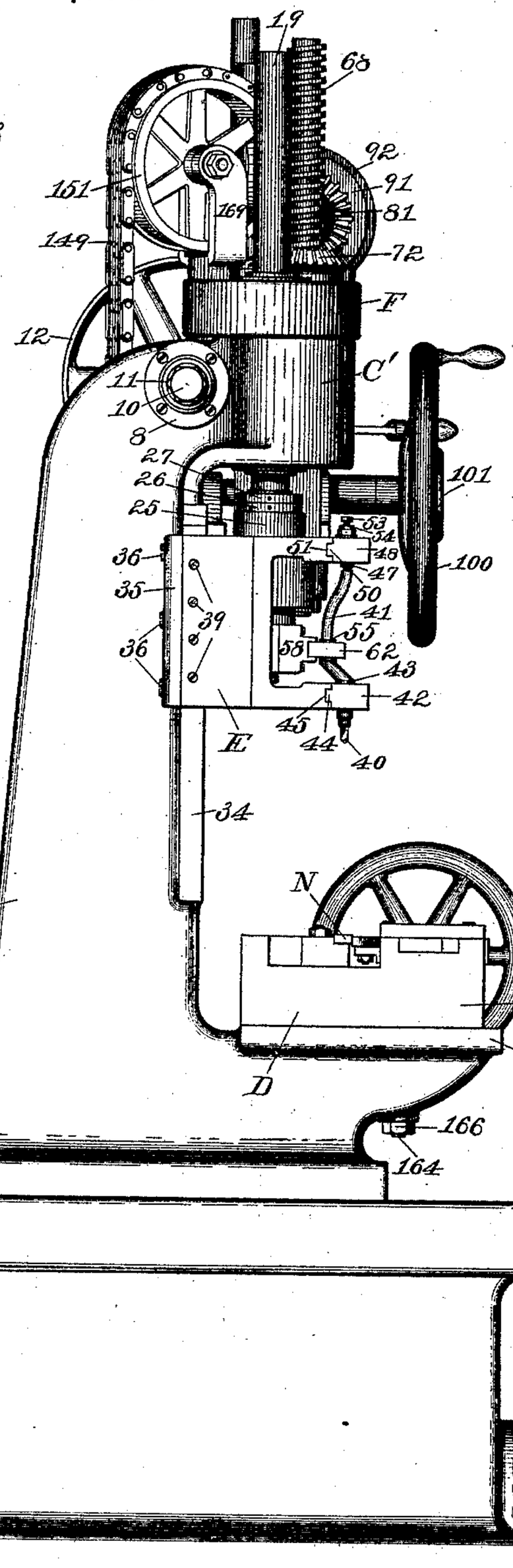


Fig. 9

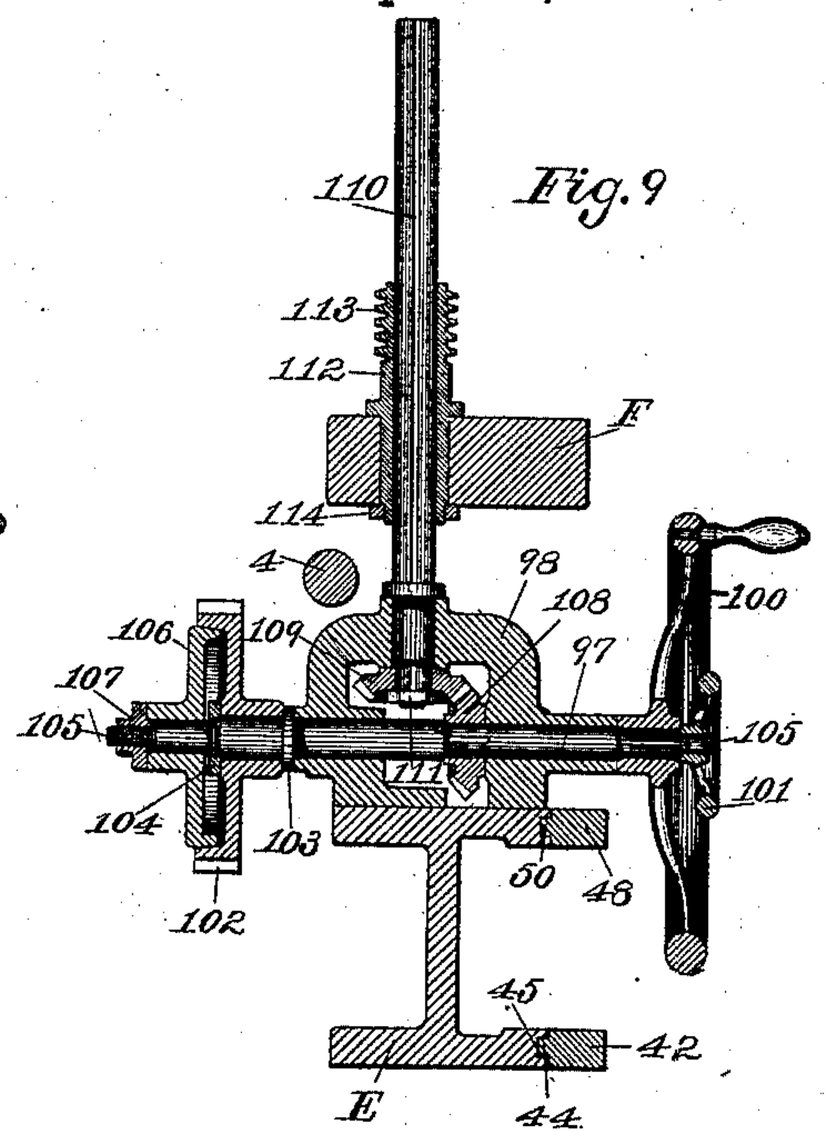
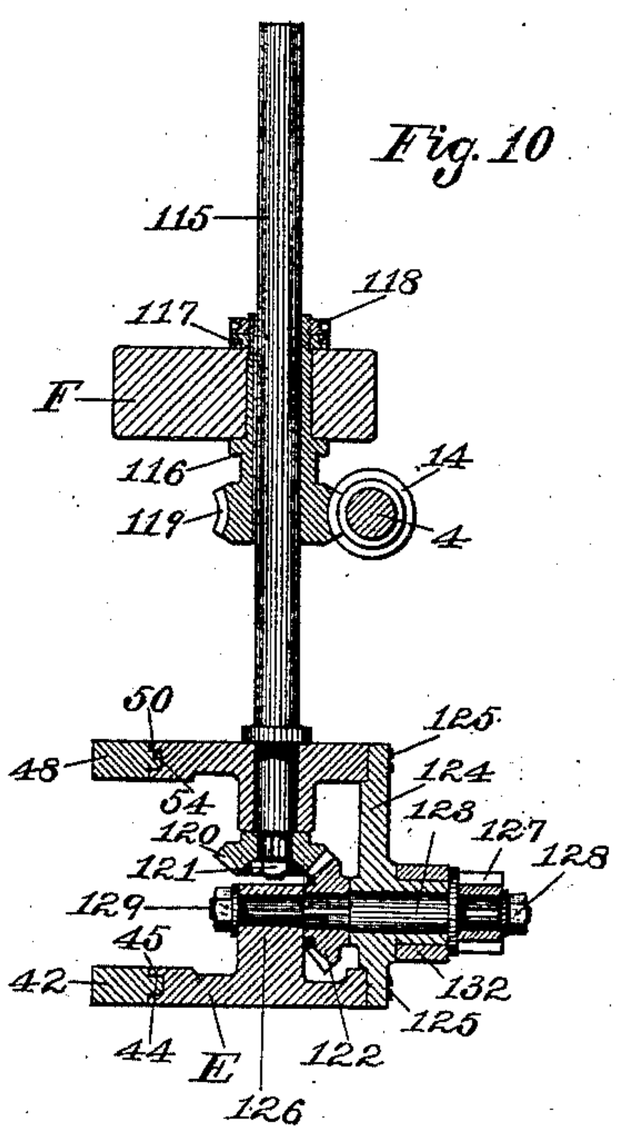


Fig. 10



Witnesses:

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(No Model.) 6 Sheets—Sheet 4.

F. H. RICHARDS.

DRILLING MACHINE.

No. 426,571. Patented Apr. 29, 1890.

Fig. 4

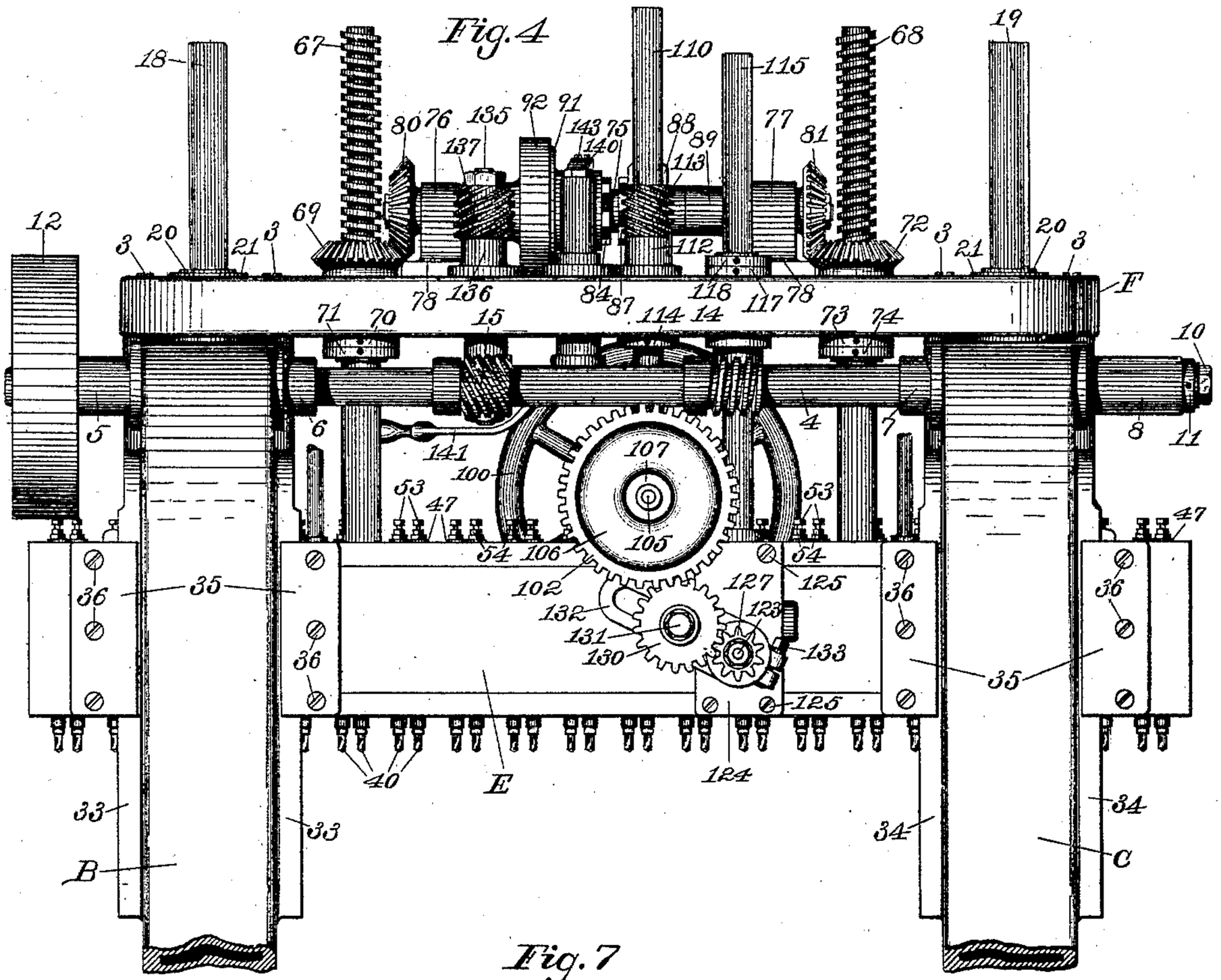


Fig. 7

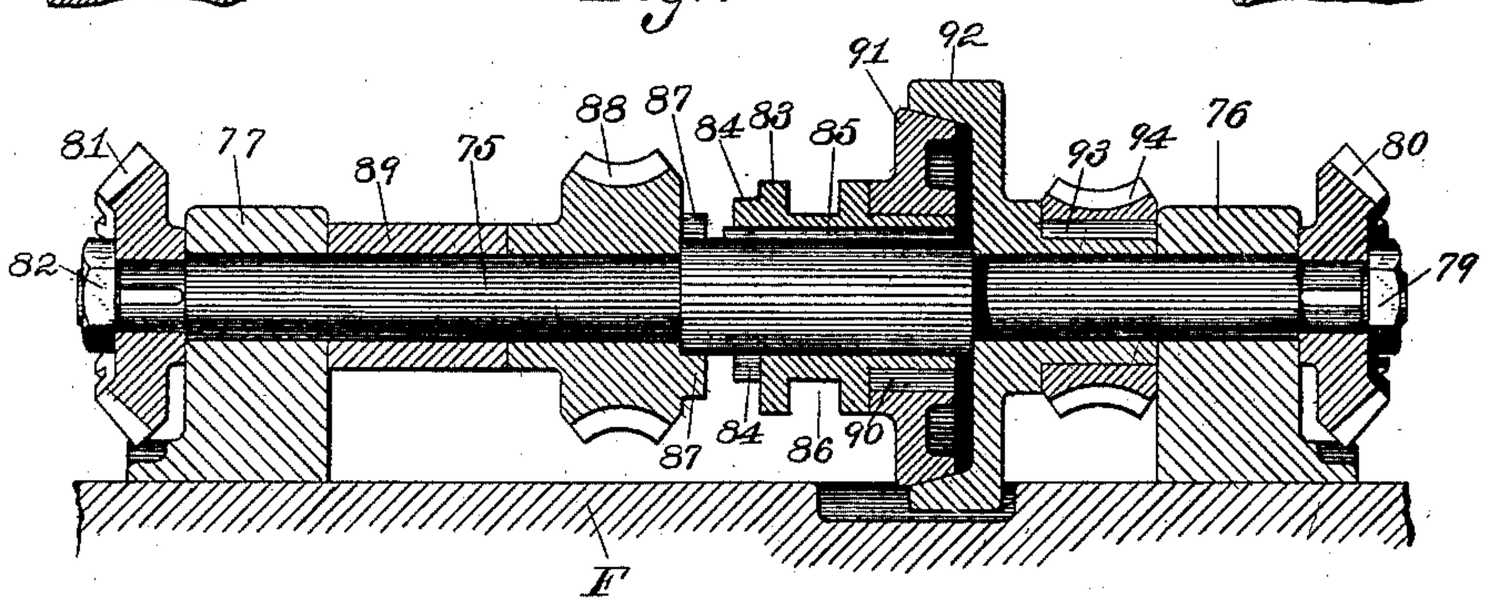
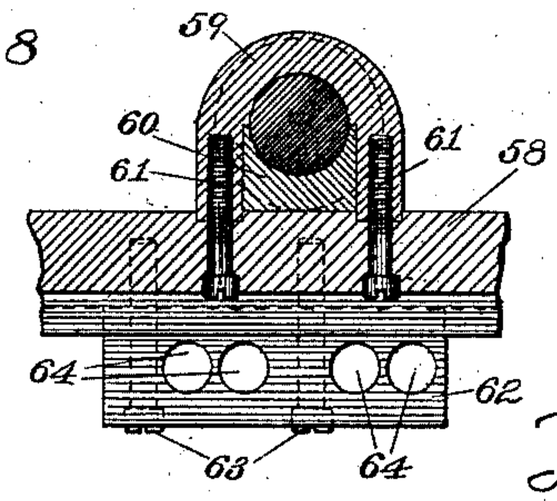


Fig. 8



Witnesses:

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L. C. Hiermann.

Inventor:

Francis H. Richards

(No Model.)

6 Sheets—Sheet 5.

F. H. RICHARDS.

DRILLING MACHINE.

No. 426,571. Patented Apr. 29, 1890.

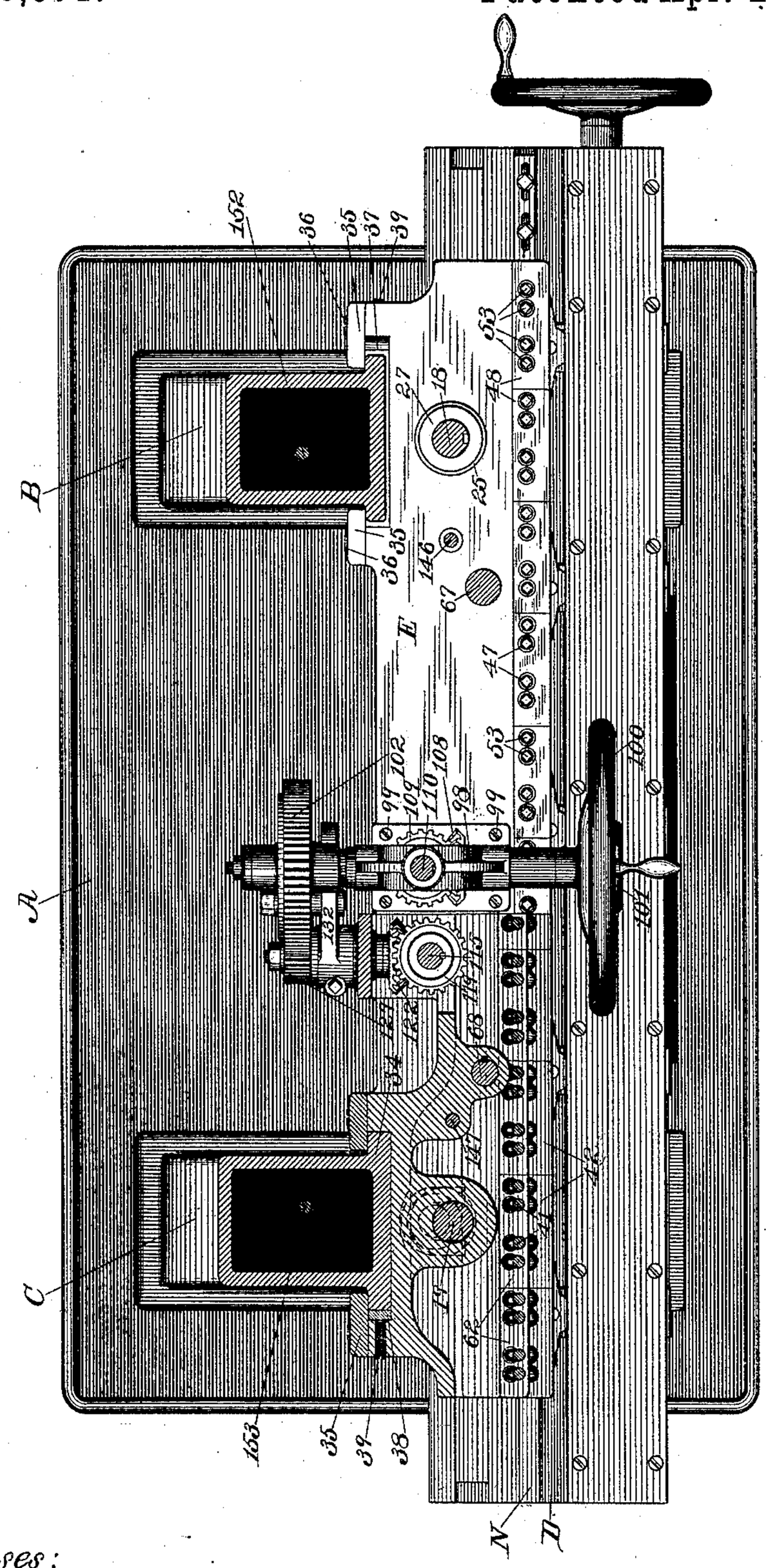

Fig. 5

Witnesses:

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(No Model.) 6 Sheets—Sheet 6.

F. H. RICHARDS.

DRILLING MACHINE.

No. 426,571. Patented Apr. 29. 1890.

Fig. 6

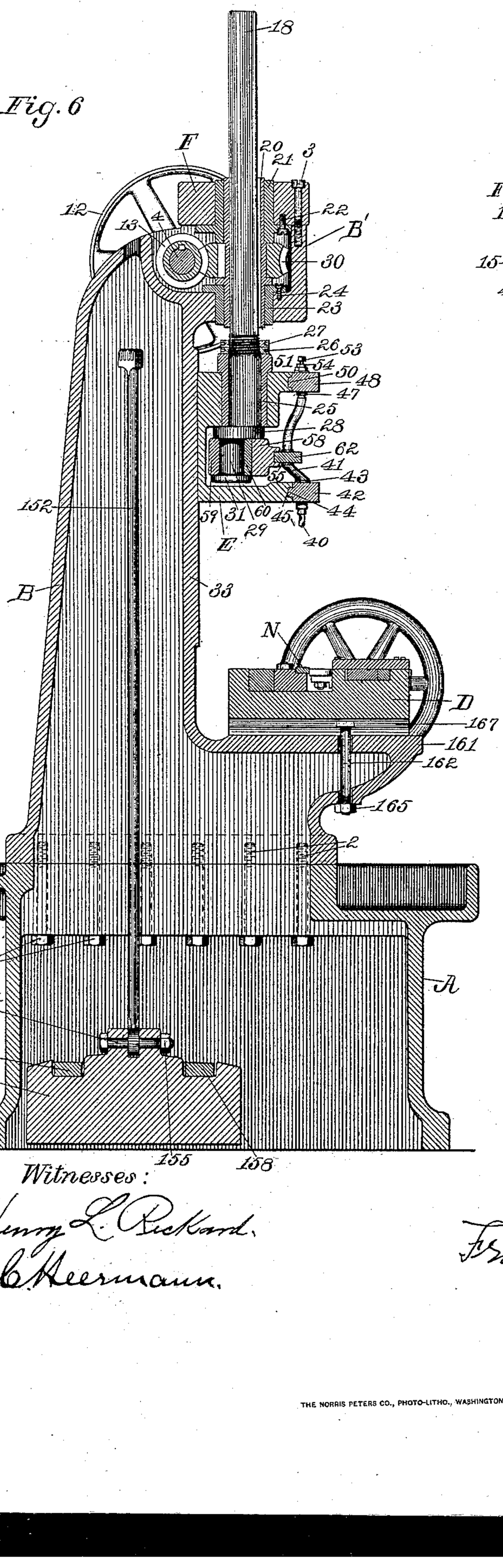


Fig. 11

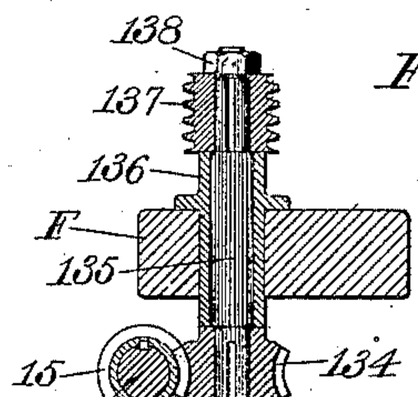
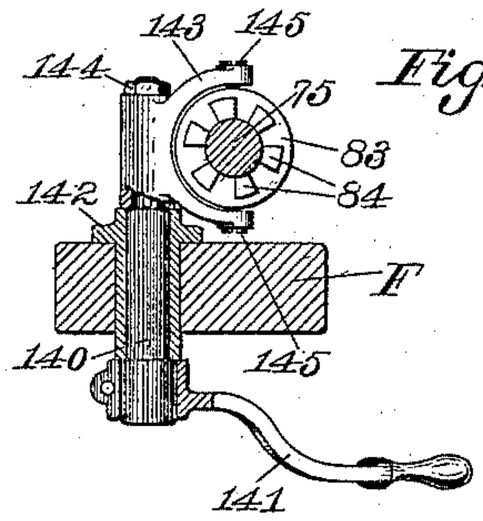


Fig. 12



Witnesses:

Henry L. Ruckard.

L. C. Hermann.

Inventor:

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UNITED STATES PATENT OFFICE.

FRANCIS H. RICHARDS, OF HARTFORD, CONNECTICUT, ASSIGNOR TO ECKLEY B. COXE, OF DRIFTON, PENNSYLVANIA.

DRILLING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 426,571, dated April 29, 1890.

Application filed November 23, 1889. Serial No. 331,389. (No model.)

To all whom it may concern:

Be it known that I, FRANCIS H. RICHARDS, a citizen of the United States, residing at Hartford, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Drilling-Machines, of which the following is a specification.

This invention relates to multiple drilling-machines of that class in which cranked spindles are actuated by a gyratory driver-plate.

The vertical drilling-machine herein shown and described is especially designed for drilling simultaneously all the holes in a mowing-machine cutter-bar or other similar article having many holes in close proximity to each other.

In the drawings accompanying and forming a part of this specification, Figure 1 is a plan view of a multiple drilling-machine embodying my present improvements. Fig. 2 is a front elevation of the machine. Fig. 3 is a side elevation of the same, as seen from the left hand in Fig. 2. Fig. 4 is a rear view of the upper part of the machine. Fig. 5 is a plan view in which some of the upper parts are broken away the better to show certain other parts. Fig. 6 is a vertical section taken on the line *a a* of Fig. 1, looking toward the right hand. Fig. 7 is a central horizontal section showing the form and construction of the horizontal feed-nut coupling-shaft and of the parts carried thereon. Fig. 8 is a fragmentary view showing the method of attaching the crank-shafts to the gyrating bar or driver-plate. Fig. 9 is a vertical sectional view showing the hand-wheel shaft and its bearings, together with some adjacent and accessory parts. Fig. 10 is a vertical section showing the feed-pinion shaft and its bearings, together with some adjacent and accessory parts. Fig. 11 is a vertical sectional view showing the form and construction of certain details of the quick-return apparatus. Fig. 12 is a similar view of the feed-clutch shaft and accessory parts.

Similar characters designate like parts in all the figures.

The cutter-bar or other article N which is to be drilled is placed in a suitable work-holder, as D, that is supported on the frame-work of the machine. The particular form of said work-holder shown in the drawings is that described and claimed in my prior application Serial No. 292,846; but other work-holders may be used—as, for instance, either of those described in my prior applications Serial Nos. 298,896, 298,897, 309,956, and 309,957.

The frame-work of this machine consists of the bed or base A, Fig. 2, the right-hand column B and the left-hand column C, both made fast to said bed by means of the screw-bolts 2, and the top plate or beam F, which is securely fastened to the top of the columns B and C by the screws 3, and which connects said columns and forms a support for various details of the mechanism. The main driving-shaft 4 is carried at its right-hand end in a pair of bearings 5 and 6, which are fixed on the column B, and at its left-hand end in a pair of bearings 7 and 8, that are fixed on the column C. Said bearings are fitted into the upper ends of the said columns and are or may be secured thereto in the usual manner by screws, as shown in the drawings. A flange 9 is formed on the shaft 4 to hold the same in place longitudinally. (See Fig. 1.) A plug 10, Fig. 4, having a squared head, is screwed into the bearing 8 to take the end-thrust of the shaft 4, the said plug or step being secured by the check-nut 11. The driving-pulley 12 is secured in any usual manner on the right-hand end of the shaft 4.

The vertical crank-shafts 18 and 19 are alike in form and construction, and a description of one of them will be sufficient for the clear understanding of their construction. Crank-shaft 18 has its bearing in the upper end of column B, and crank-shaft 19 has its bearing in the column C. Referring to Fig. 6, the shaft 18 is shown provided with a sleeve 20, to which it is splined in the usual manner. A bushing 21 is fitted into the top bar F and is secured by the holding-screws 22. Another and similar bushing 23 is fitted into the bore shown in the projecting upper end B′ of the column B, (see Fig. 6,) and is secured in a like manner by the screws 24. These two bushings constitute the upper and lower bearings, respectively, for the said tubu-

lar shaft 20. The said crank-shafts 18 and 19 each have a lower bearing 25, which is fitted in or is formed on the cross-beam E. Said shafts are held in place vertically in their said bearings by the ring-nuts 26 and 27 and by the flanges 28 that are formed thereon. The shafts 18 and 19 have cranks 29 formed on the lower ends thereof, and are driven by the driving-shaft 4 through the worms 13, which are keyed to the said shaft 4 in a well-known manner, and which mesh with the worm-wheels 30, that are keyed fast to the said shafts or sleeves 20.

The cross-beam E is arranged to slide vertically on the ways or guides 33 and 34, which are formed on the columns B and C, respectively. Said beam is fitted with the straps 35, secured thereto by the screws 36, Fig. 4. The beain E is also provided with the shoes or gibs 37 and 38 to take up the wear, the shoes bearing on the outer edges of the guides 33 and 34, respectively, being adjusted by the screws 39. (See Figs. 3, 4, and 5.)

The drills 40 are removably secured in the lower ends of the cranked drill-spindles 41, Fig. 6, which have their lower bearings in the lower bearing-blocks 42, that are preferably furnished with the renewable bearing-bushings 43. The said blocks 42 have formed on the rear side thereof the tongues 44, which fit into the corresponding groove 45, formed in the cross-beam E, said blocks being secured to said beam by the holding-screws 46, Fig. 2. The drill-spindle steps 47 are screwed into the upper bearing-blocks 48, Fig. 6, being secured therein by the set-screws 49. The blocks have formed on the rear side thereof the tongues 50, (similar to tongues 44,) which fit into the corresponding groove 51, (similar to groove 45,) formed in the cross-beam E. Screws 52 serve to hold the said blocks 48 in place. The steps 47 form the upper bearings for the spindles 41, the reduced upper ends of which fit into the holes or sockets formed in the lower ends of said steps. Thrust-screws 53 are screwed into the upper ends of the steps 47 to take the upward thrust of the drills 40, and are provided with the usual check-nuts 54.

The gyratory driving-bar 58, Fig. 6, is carried and operated by the aforesaid cranks 29, which are fitted in the bearings on said bar. These bearings consist of the bearing-straps 59 and the bearing-blocks 60, fitted between the flanges 28 and 31 of said cranks and secured to the said bar 58 by the holding-screws 61. (See Figs. 5, 6, and 8.) A series of crank-bearing blocks 62 are fitted into a groove formed to receive them in the gyrating bar 58, and are firmly held in place by the holding-screws 63. The drill-spindles 41 have crank-bearings 55, which fit freely in the holes 64, that are formed in the said driving-blocks 62.

For properly and conveniently operating the beam E to elevate and lower the same I have provided a feed mechanism constructed to operate by power as a slow downfeed and also as a quick-return motion. Means are also provided to raise and lower the beam by hand. In using the machine it is deemed desirable to first lower the beam a little way by hand to bring the drill-points down close to the bar N and then to engage the downfeed. The drills having completed their work, the operator stops the downfeed, when the beam may be elevated slowly by hand or quickly by means of the quick-return feed.

The construction of the feed apparatus may be described as follows: The vertical feed-screws 67 and 68, Fig. 4, are rigidly fixed at their lower ends in the beam E, the first screw being a right-hand and the second a left-hand one. The hub of the miter gear 69 is threaded to fit the feed-screw 67, and thus to constitute the right-hand feed-nut. Said hub passes through a bearing in the top plate F and is secured therein by the nuts 70 and 71. Similarly the hub of the miter-gear 72 constitutes a feed-nut for the feed-screw 68, it being carried in a bearing in the top plate F and secured therein by the nuts 73 and 74. A horizontal feed-shaft 75 is journaled in the feed-shaft bearings 76 and 77, which are secured onto the upper side of the top plate F by the holding-screws 78. (See Fig. 7.) Said shaft 75 carries the gears 80 and 81, (fixed thereon by keys and nuts 79 and 80,) which mesh with the said gears 69 and 72, respectively. The feed-clutch 83, having thereon the clutch-teeth 84, is fitted by a spline 85 to slide on the enlarged middle part of the feed-shaft 75. (See Fig. 7.) Said clutch also has the groove 86 formed thereon. The clutch-teeth 84 are designed to engage with the clutch-teeth 87, which are formed on the worm-wheel 88 of the feed mechanism, the said gear being fitted to turn freely on the feed-shaft 75. A sleeve or collar 89 is or may be fitted onto the shaft 75, between the worm-wheel 88 and the shaft-bearing 77, to hold said wheel in proper position on said shaft. Secured to the clutch 83 by the key 90 is the inner friction-rim 91, which rim fits within the outside friction-rim 92, that is fitted to turn freely on the feed-shaft 75, and on which is fixed (by key 93) the quick-return worm-wheel 94. This wheel 94 is actuated directly from the main shaft 4 through a simple system of toothed gearing, consisting of the screw gear or worm 15 on shaft 4, the wheel 134, meshing with and driven by said worm 15 and fixed on the shaft 135, that is carried in the bearing 136, fixed in plate F, and the worm 137, meshing with and driving the said wheel 94. (See Fig. 11.) This gearing runs continuously during the operation of the machine. When it is desired to elevate the beam E, this quick-return mechanism is set into operation by means of the handle 141, fixed on the shaft 140, which is carried in the bearing 142 in the plate F, and which carries thereon the forked arm 143, whose pins 145 engage in the groove 86 of

the clutch-sleeve 83. The operator, seizing said handle, forces the clutch-teeth 84 out of engagement with clutch-teeth 87 of the wheel 88, and thereby frees the shaft 75 from its connection with the downfeed mechanism. At the same time the friction-rim 91 is forced into the rim 92, thereby causing the shaft 75 to be revolved in a direction to turn the aforesaid feed-nuts to elevate the beam F. (See Figs. 7 and 12.) In practice the angle of the friction-surfaces of said friction-rims should be such that they will only operate while the operator forcibly holds them in contact, since this arrangement is found in such cases to give a greater degree of control over the action of the machine.

The feed mechanism for feeding down the beam F is actuated from the shaft 4 through a different apparatus, which will now be described in detail. The hand-wheel shaft 97 is journaled in the bearing bracket or frame 98, which is carried on the upper side of the cross-beam E and is held in place by the screws 99. The large hand-wheel 100 is keyed in the usual manner on the shaft 97 at the front end thereof. (See Fig. 9.) Near the rear end of the shaft 97 is fitted the large friction-wheel 102, which is held in place thereon against the flange 103 by the ring-nut 104. The hand-wheel shaft 97 is formed hollow, and the friction-rod 105 passes through it. Pinned to the front end of the rod 105 is the small hand-wheel 101, for engaging and disengaging the downfeed friction-wheel. The friction disk or wheel 106 is fitted on the rear end of the shaft 97 by a spline. (Not shown.) A nut 107 is fixed to the hub of the friction-disk 106 in a well-known manner by screws, (not shown,) and is threaded to receive the threaded rear end of the said friction-rod 105, as indicated in the drawings. A miter-gear 108 is fixed on the shaft 97 and meshes with another and similar miter-gear 109, which is fixed on the lower end of the vertical feed-shaft 110 in the usual manner by a key and by the nut 111. The shaft 110 is splined in the sleeve 112, which is fitted to turn in a bearing in top plate F, being held therein by the nut 114. Said sleeve 112 has formed thereon the worm 113, which meshes with and drives the aforesaid worm-wheel 88 on the horizontal feed-shaft 75. (See Figs. 1 and 7.) If, now, said wheel 88 be held by the said clutch 83 from rotation on said shaft, then it is obvious that by turning the hand-wheel 100, Fig. 9, the beam E may be raised or lowered, since said wheel will then be geared to turn the said feed-nuts on the feed-screws 67 and 68, Fig. 4. This apparatus constitutes the hand-power feed mechanism. The automatic feed mechanism comprises the said hand-power feed apparatus and devices for actuating the same by power. (See Figs. 1, 4, 5, and 10.) The vertical driving feed-shaft 115 is journaled in the cross-beam E and is splined to the sleeve 116, which is carried in a bearing in the top bar F and is held in place therein by the nuts 117 and 118. On the lower end of the sleeve 116 is formed the worm-wheel 119, which meshes with the worm 14 on the driving-shaft 4. The lower end of the shaft 115 carries the gear 120, (secured thereon by a key and by the nut 121,) which meshes with the gear 122, that is fixed in the usual manner to the feed-pinion shaft 123, supported in the bearings 124 and 126. The bearing 126 is shown formed on the beam E, while the bearing 124 is held thereon by the holding-screws 125. The feed-pinion 127 is removably secured on shaft 123 by a key, as shown, and by nut 128, the nut 129 serving to hold the said shaft in place. A changeable intermediate feed-wheel 130 is adjustably fixed by the usual stud 131 to the adjustably-fixed arm 132 in a well-known manner, said arm being clamped onto the projecting part of bearing 124 by the clamp-screw 133. The wheel 130 communicates power from the pinion 127 to the said friction-wheel 102, and said three spur-wheels constitute a set of "change-wheels" similar to those ordinarily used for the feed mechanisms of metal-working tools in general. By turning the wheel 101 the screw-shaft 105 may be turned to draw the disk 106 into frictional engagement with the said wheel 102, thus completing an operative connection between the driving-shaft 4 and the beam-elevating screws by way of the said hand-power apparatus—that is, through shaft 97 and gears 108 and 109 to shaft 110—and from this shaft through worm 113, gear 88, and the clutches to the shaft 75, that is geared to said screws.

Having thus described the construction of the feed mechanism, the mode of operation thereof will now be readily understood.

For the purpose of lessening the power required to raise the cross-beam E, I employ a counterbalancing apparatus, which I construct as follows: The short counterbalance-rods 146 and 147 are fixed to the beam E by nuts, as shown in Fig. 2. To the upper ends of said rods are secured the counterbalance-chains 148 and 149, which are carried on the chain-pulleys 150 and 151, that are carried by the pulley-supports 168 and 169, respectively, secured to the top bar F. Passing over said pulleys and down on the opposite side, and passing through openings formed in the tops of the columns B and C and into the interior thereof, the said chains 148 and 149 are attached to the upper ends of the long counterbalance-rods 152 and 153. Fig. 6 shows the interior of the column B and the base A, and shows the method of attaching the counterbalance-weights to the rods 152 and 153. As said rods are substantially alike, a description of one will suffice. Referring again to Fig. 6, the bolt 154 is shown passing through the right-hand weight 156 and through the eye formed on the lower end of the rod 152 and secured by the nut 155. The bent weight-supporting bars 158 and 159 rest on top of the end weights 156 and 157, fitting into

grooves formed in said weights in the manner shown. One or more additional weights 160 are placed on the said bars 158 and 159, as shown in Fig. 2. Holes 170, formed in the weights 160, furnish a means for putting in place and removing the same. A bar being put through the weight, this is thereby readily lifted and removed. On the projecting part 161 of column B and 162 of column C rests the aforesaid vise or work-holder D, which is removably secured thereto by the T-head bolts 163 and 164, whose heads fit into the T-shaped slots 167, formed in the bed-plate of the vise and are furnished with the ordinary nuts 165 and 166, respectively.

While my improvements are herein described as embodied in a "vertical" machine, it will of course be understood that such arrangement is not essential, and that nearly all of the features set forth are equally applicable to the horizontal type of drilling-machine.

Having thus described my invention, I claim—

1. In a drilling-machine, the combination, with a supporting frame-work, of the drill-carrying beam movable thereon and having upper and lower drill-spindle bearings, a series of drill-spindles in said bearings and cranked intermediate thereto, the driver-bar engaging said cranked drill-spindles, and the driving-shafts carrying said driver-bar on the cranks thereof, said driving-shafts being journaled in said beam, all substantially as described.

2. In a drilling-machine, the combination, with a supporting frame-work, of the beam movable thereon and carrying cranked drill-spindles, substantially as described, the driver-bar engaging the cranks of said spindles and carried on the cranks of driving-shafts journaled in said beam, driving apparatus connecting and simultaneously revolving said driving-shafts, and feed mechanism for moving the beam on said frame-work, all substantially as described.

3. In a drilling-machine, the combination, with a supporting frame-work, of the beam movable thereon and carrying cranked drill-spindles, substantially as described, the driver-bar engaging the cranks of said spindles and carried on the cranks of driving-shafts which are journaled at one end in said beam and are splined at the other end to driving-wheels that are journaled in the frame-work, driving apparatus connecting and simultaneously revolving said wheels, and feed mechanism for moving said beam on the frame-work, all substantially as described.

4. In a drilling-machine, the combination, with a supporting frame-work, of the drill-carrying beam movable thereon, the cranked drill-spindles carried on said beam, the driver-bar engaging the cranks of said spindles, the driving-shafts journaled in the beam and carrying said driver-bar on the cranks thereof, driving apparatus connecting and simultaneously revolving said driving-shafts, feed-screws fixed in the beam, feed-nuts engaging said screws and journaled in the frame-work, and connecting-gearing simultaneously actuating said feed-nuts, all substantially as described.

5. In a drilling-machine, the combination, with a supporting frame-work, of the beam movable on said frame-work and furnished with drilling appliances, substantially as described, the driving-shafts journaled in said beam and connected to actuate the drills thereon, shaft 4, journaled in the frame-work and connected to simultaneously revolve said driving-shafts, the feed-screws connected to said beam, the feed-nuts journaled in the frame-work and connected by a coupling-shaft and gearing for simultaneous operation, and feed-gearing connecting shaft 4 and said coupling-shaft through a clutch intermediate to said shafts, all substantially as described.

6. In a drilling-machine, the combination, with a supporting frame-work and with the movable drill-carrying beam thereon, of the main driving-shaft journaled in the frame-work and connected by driving apparatus to actuate the drills independently of the movement of the beam, the coupling-shaft connecting the feed-nuts for moving the beam, and two feed apparatuses connecting said driving-shaft with said coupling-shaft, each said apparatus having therein a clutch intermediate to said shafts, and means for engaging and disengaging said clutches, all substantially as described.

7. In a drilling-machine, the combination, with the main driving-shaft and with the feed-shaft 75, connected to the feed-screw, of the driven wheels carried freely on said feed-shaft and actuated in opposite directions by gearing from said main shaft, and a clutch on said feed-shaft for engaging and disengaging said wheels one at a time, all substantially as described.

8. In a drilling-machine, the combination, with the main driving-shaft and with the feed-shaft 75, connected to the feed-screw, of the wheels 88 and 94, oppositely revolved by gearing from said main shaft, the friction-rim carried by said wheel 94, and the clutch constructed to frictionally engage said rim and the feed-shaft and to positively engage said wheel 88 and the feed-shaft, all substantially as described.

9. In a drilling-machine, the combination, with the main driving-shaft and with the feed-shaft 75, connected to the feed-screw, of the friction-wheel on said feed-shaft and actuated by gearing directly from said main shaft, the clutch-wheel 88, actuated indirectly from said main shaft by feed apparatus which has therein a friction-clutch that is intermediate to said main shaft and wheel 88, and the clutch on said feed-shaft constructed to

frictionally engage said friction-wheel and to engage said wheel 88 one at a time, all substantially as described.

10. In a drilling-machine, the combination, with the feed-shaft 75, connected to the feed-screw, and with the clutch-wheel and the friction-wheel on said shaft and oppositely driven, substantially as described, of the clutch 83, splined to said shaft and having the rim 91 to engage said friction-wheel, and having clutch-teeth to engage said clutch-wheel, and means for sliding the clutch on said shaft to engage said wheels alternately, all substantially as described.

11. In a drilling-machine, the combination, with the main driving-shaft and with the movable drill-carrying beam, of the feed-shaft connected to actuate said beam, the reversely-actuated wheels on said feed-shaft, and means to engage and disengage said wheels one at a time, the splined shaft 115, driven from said main shaft and geared to drive the shaft 123 on the beam, the shaft 97, carried on the beam and actuated by change-wheels from said shaft 123, and a connecting-shaft and gearing from said shaft 97 to one said wheel on said feed-shaft, all substantially as described.

12. In a drilling-machine, the combination, with the movable beam, of the main shaft 4, the wheel 119, journaled in the frame-work and fitted to receive a splined shaft, the shaft 115, splined to said wheel and journaled at one end in said movable beam, the shaft 123, carried in bearings on the beam, gearing connecting said shafts 115 and 123, and connecting shafts and gearing actuating the beam from said shaft 123, all substantially as described.

13. In a drilling-machine, the combination, with the movable beam E, having bearings 126 and 124, of the shaft 115, journaled in said beam and actuated from the driving-shaft of the machine, the shaft 123, carried in bearings 126 and 124 and provided with the change-wheel 127, and gearing connecting shafts 115 and 123, said wheel 127 being connected by intermediate mechanism to actuate said beam, all substantially as described.

14. In a drilling-machine, the combination, with a frame-work and with the main driving-shaft and the movable beam carried thereon, of the feed-shaft carried on the frame-work and connected to actuate the beam, the wheel 88 on said feed-shaft, the shaft 110, journaled in a bearing on the beam and connected to actuate said wheel 88, the shaft 97, carried on the beam and geared to actuate shaft 110, means for turning shaft 97 by hand, and connecting mechanism actuating shaft 97 from said main shaft through a clutch intermediate to these shafts, all substantially as described.

15. In a drilling-machine, the combination, with a frame-work and with the main driving-shaft and the movable beam carried thereon, of the feed-shaft connected to the feed-screws to move said beam, the reversely-revolving wheels on said feed-shaft, and means to engage said wheels one at a time with said feed-shaft, gearing continuously actuating one said wheel from the main shaft, shaft 110, geared to actuate the other said wheel, shaft 115, geared to actuate from the main shaft, said shafts 110 and 115 being also journaled in bearings on the beam, and connecting mechanism actuating shaft 110 from shaft 115 through a clutch intermediate to these said shafts, all substantially as described.

16. In a drilling-machine, the combination, with a frame-work carrying the main shaft 4 and having the top plate F, of the movable beam, the feed-shaft 75, carried in bearings on said top plate and connected by screws to move said beam, wheel 94 on shaft 75, means engaging and disengaging said wheel from said shaft, shaft 135, carried in a bearing in said plate, worm 137, driving said wheel 94, and gearing connecting shaft 4 to drive-shaft 135, all substantially as described.

17. In a drilling-machine, the combination, with the column B, having the projecting upper end B′ bored substantially as described, of the top plate F, the beam movable on said column below said end B′ and in parallelism with said bore, the shaft 18, journaled in said beam and splined to the driving-wheel 30 in said end B′, said wheel 30 being supported by bearings, substantially as shown, and a driving-shaft geared to drive said wheel 30, all substantially as described.

18. In a drilling-machine, the combination, with the bed A, of the columns B C, the beam E, movable on said columns and counterbalanced by weights 156 and 157, one or more weight-supporting bars carried on said weights, and removable weights on said bars, all substantially as described.

FRANCIS H. RICHARDS.

Witnesses:
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