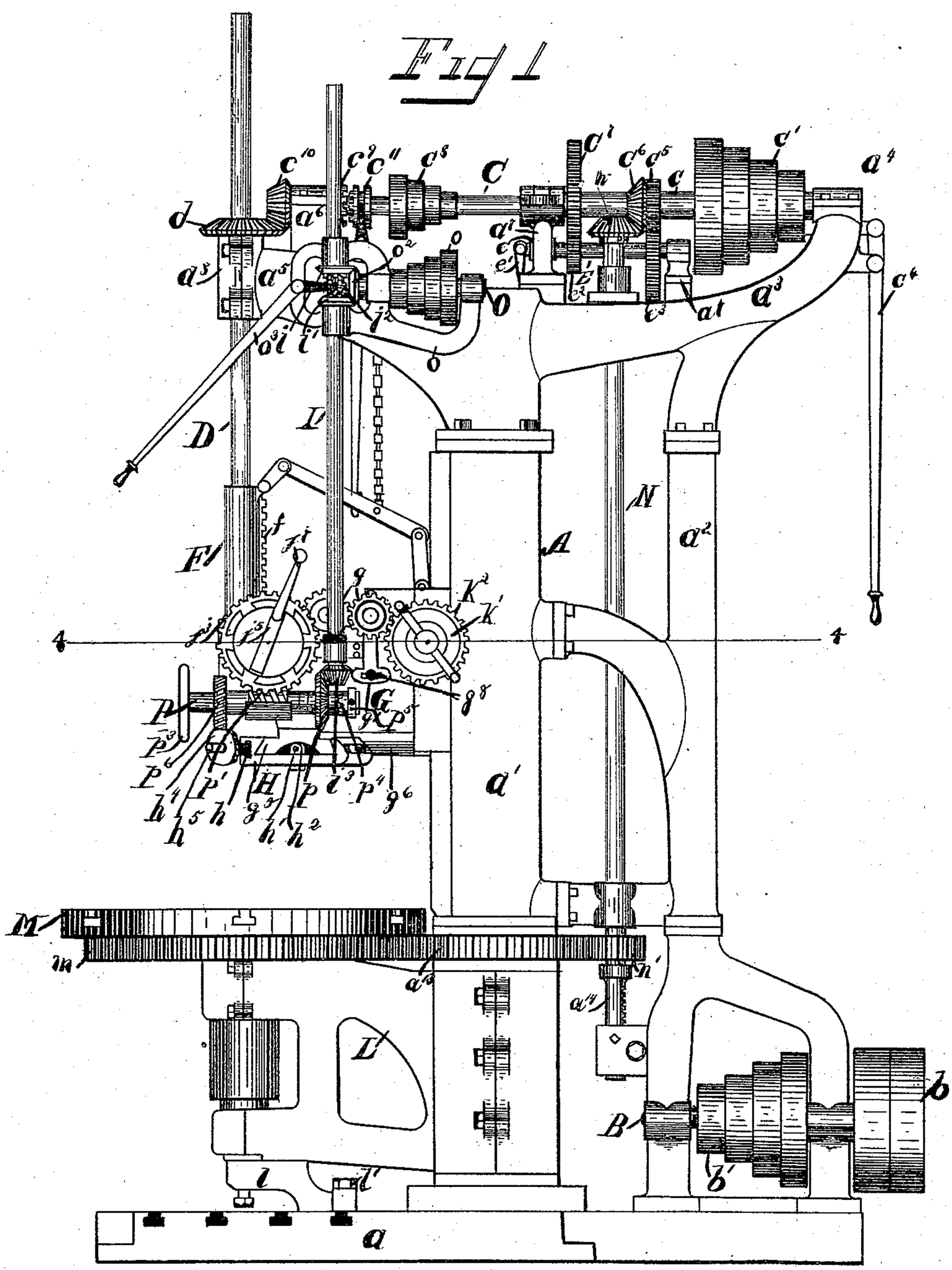
(No Model.) 6 Sheets—Sheet 1.

A. MILL.

DRILLING MACHINE.

No. 543,395. Patented July 23, 1895.

Fig 1



Witnesses
Ernest H. Hood.
Arthur E. George.

Inventor
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By Attorney
Geo. B. Barton

(No Model.)

6 Sheets—Sheet 2.

A. MILL.

DRILLING MACHINE.

No. 543,395. Patented July 23, 1895.

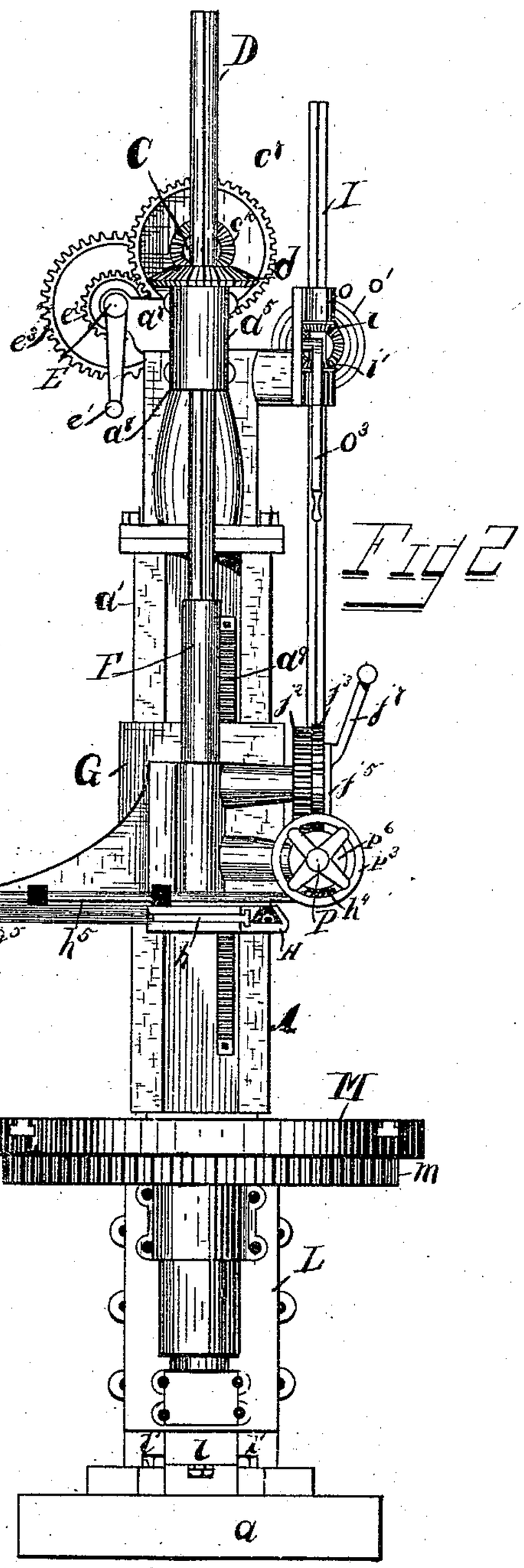

Fig 2

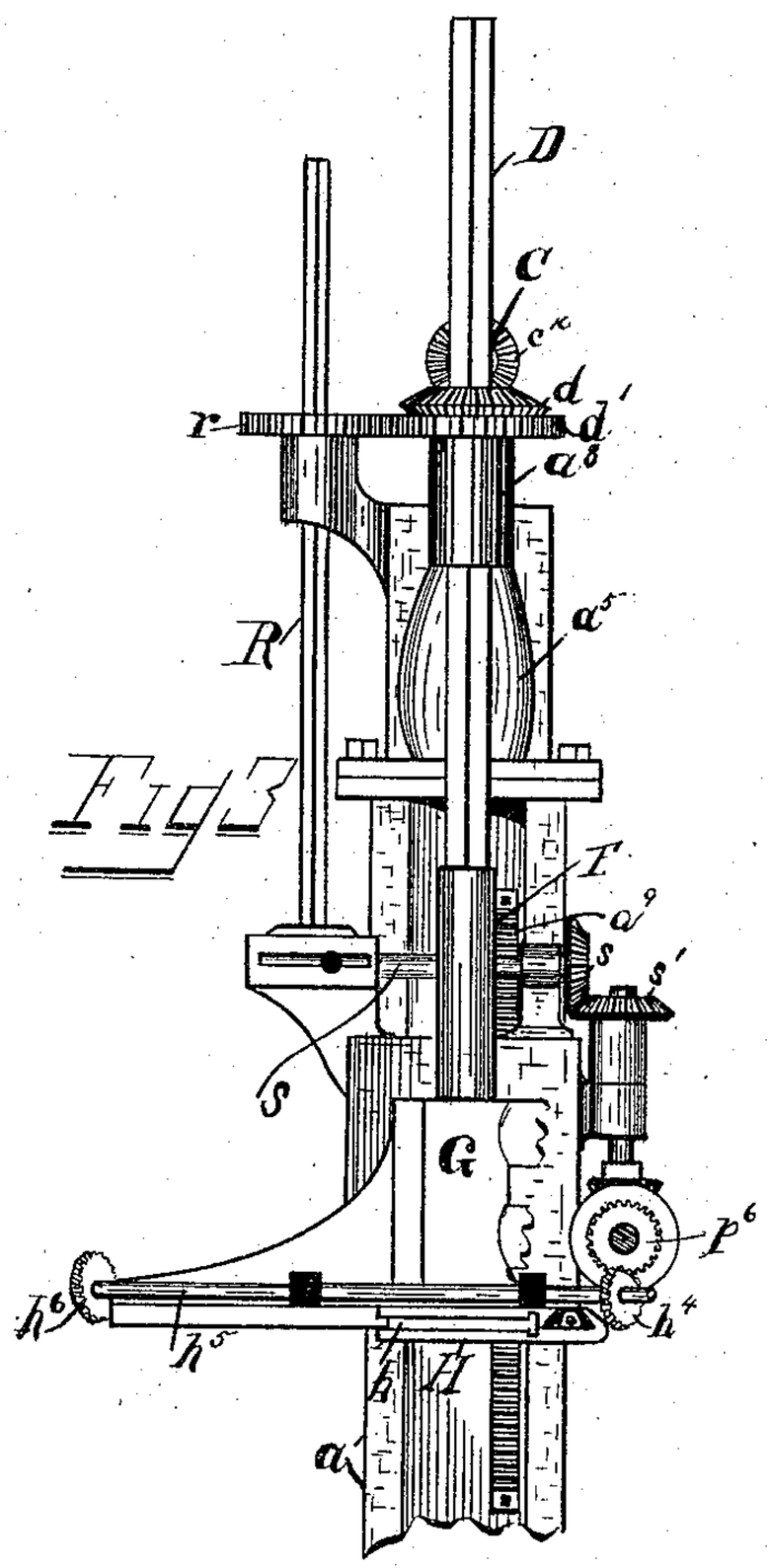

Fig 3

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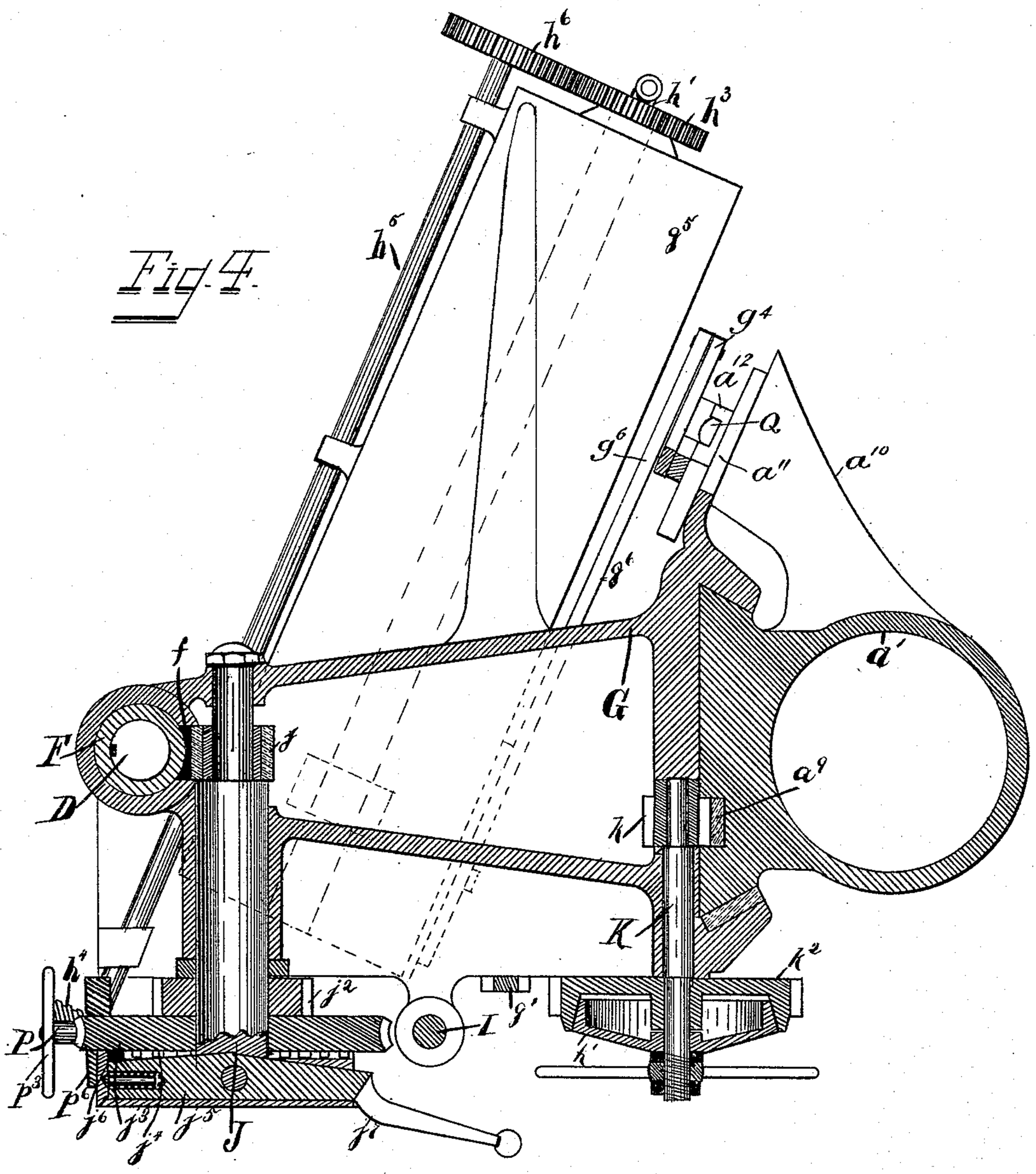
(No Model.) 6 Sheets—Sheet 3.

A. MILL.

DRILLING MACHINE.

No. 543,395. Patented July 23, 1895.

Fig. 4.



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(No Model.) 6 Sheets—Sheet 4.

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DRILLING MACHINE.

No. 543,395. Patented July 23, 1895.

Fig 5

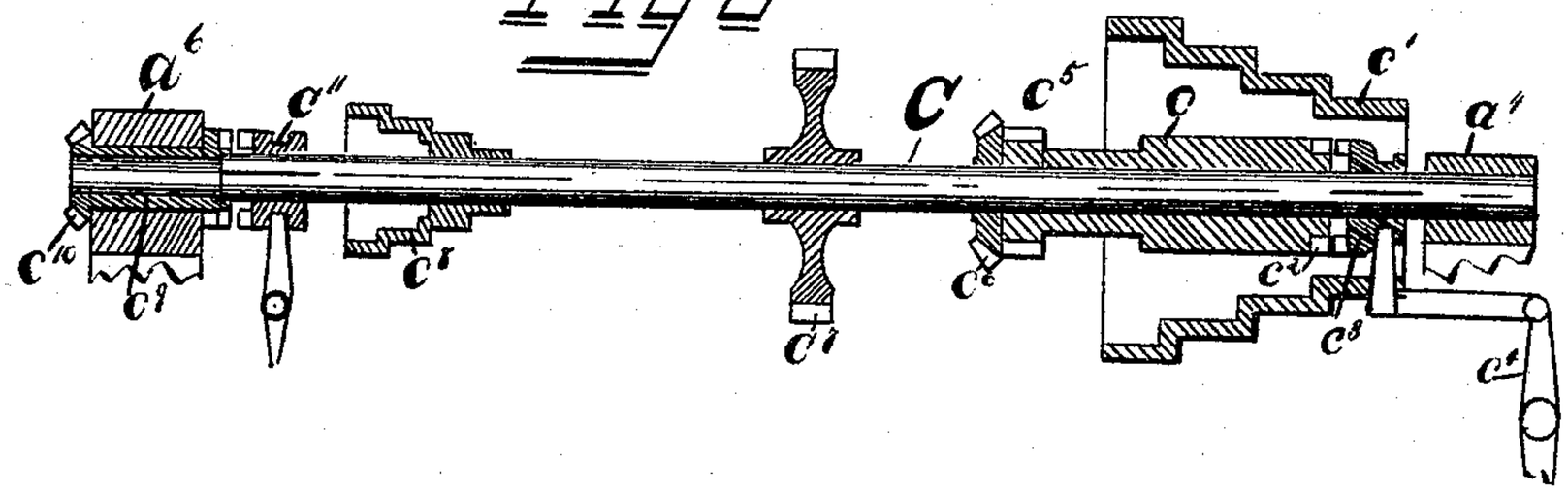


Fig 6

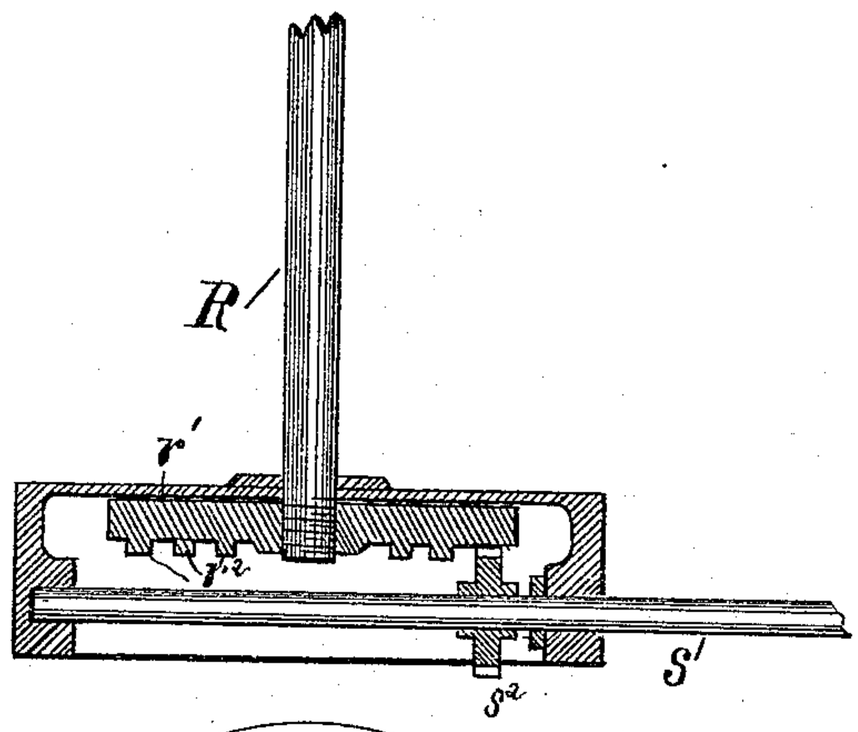
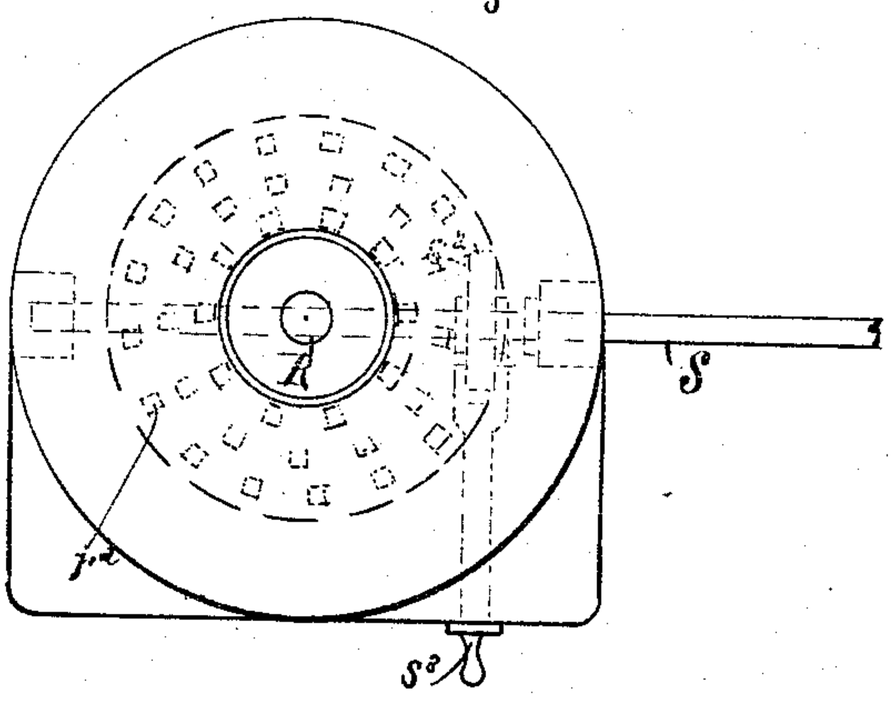


Fig 7



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6 Sheets—Sheet 5.

A. MILL.

DRILLING MACHINE.

No. 543,395. Patented July 23, 1895.

Fig 8.

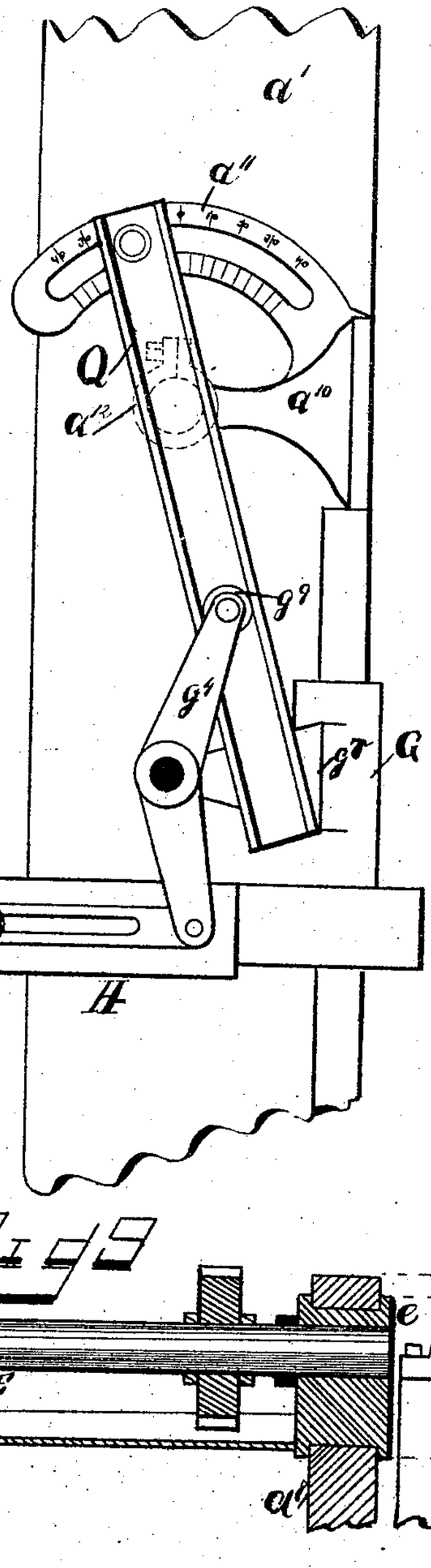
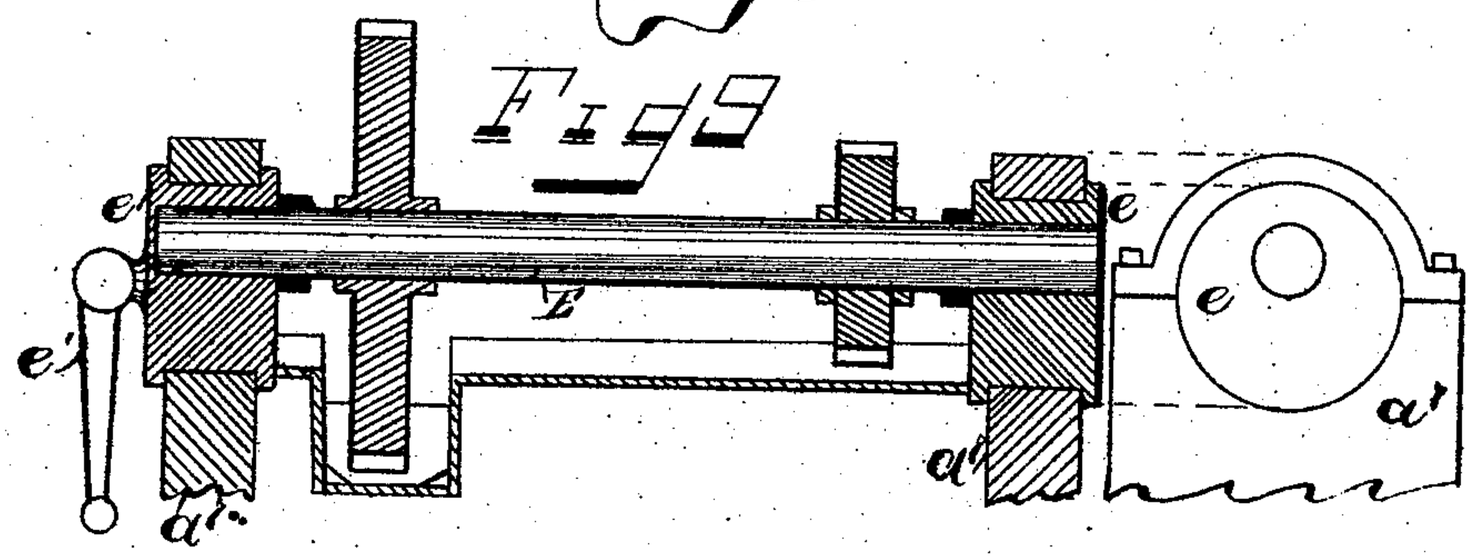


Fig 9.



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(No Model.) 6 Sheets—Sheet 6.

A. MILL.

DRILLING MACHINE.

No. 543,395. Patented July 23, 1895.

Fig. 10.

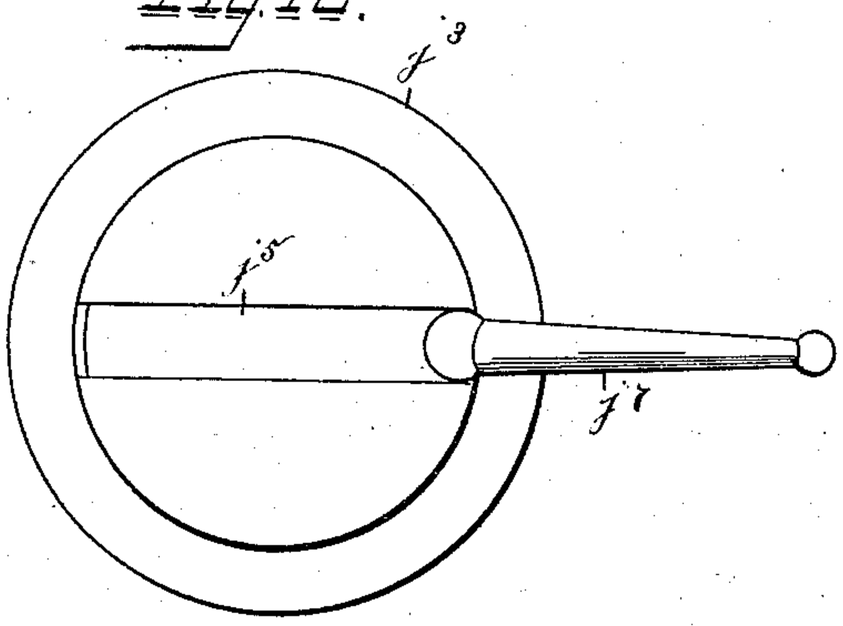


Fig. 11

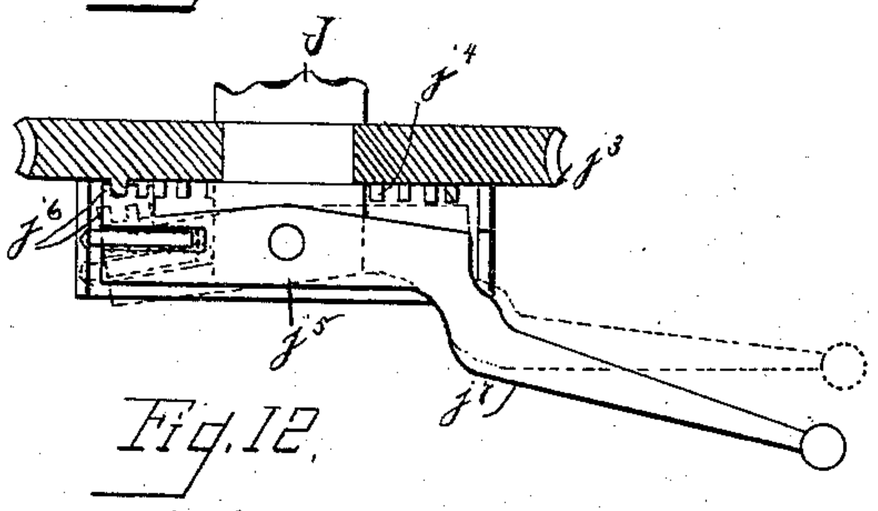


Fig. 12.

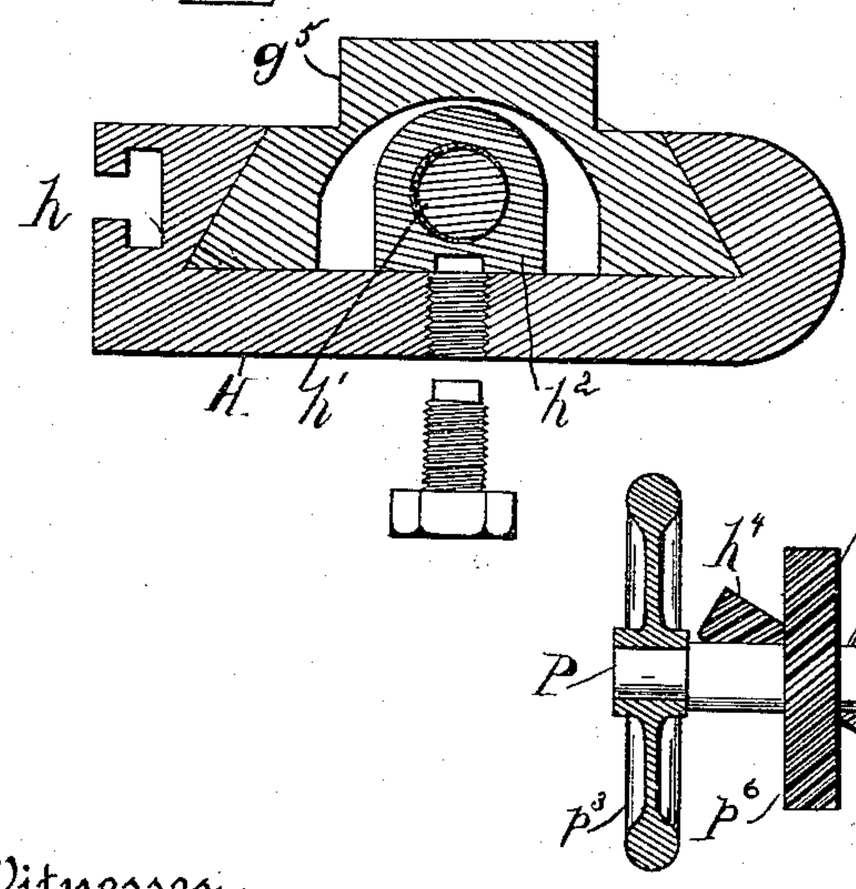
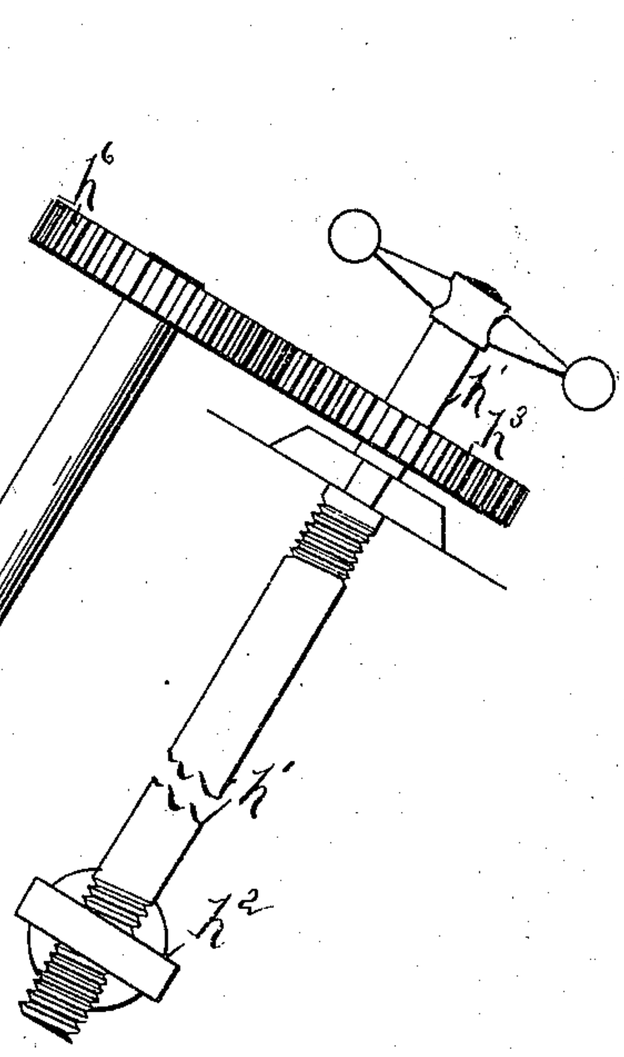


Fig. 13.



Witnesses,
Ernest H. Wood.
Arthur C. Georgi.

Inventor
Anton Mill,
By his Attorney,
Geo. B. Barlow

UNITED STATES PATENT OFFICE.

ANTON MILL, OF CINCINNATI, OHIO.

DRILLING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 543,395, dated July 23, 1895.

Application filed November 1, 1894. Serial No. 527,663. (No model.)

To all whom it may concern:

Be it known that I, ANTON MILL, a citizen of the United States of America, residing at Cincinnati, in the county of Hamilton and State of Ohio, have invented certain new and useful Improvements in Drilling, Boring, and Turning Machines, of which the following is a specification.

The object of my invention is, first, to combine with a vertical drilling-machine mechanism for truing, turning, and like work; second, to provide a compact and efficient machine for all kinds of drilling, boring, and turning; third, to provide simple and efficient means whereby the movable parts may be manipulated manually or mechanically; fourth, to provide an arrangement of clutches whereby the movable parts may be operated simultaneously or individually, and, fifth, in an arrangement and connection of the parts whereby the relative speed and direction of movement of each may be governed.

My invention consists in the mechanism and combination and arrangement of mechanism hereinafter described and claimed.

In the drawings, Figure 1 is a side elevation of my machine; Fig. 2, an end elevation; Fig. 3, a partial end elevation showing a modified form of feeding mechanism; Fig. 4, an enlarged transverse section of a part of the machine on line 4 4 of Fig. 1; Fig. 5, an enlarged longitudinal section of the upper driving-shaft; Fig. 6, an enlarged section of a portion of the modified feeding mechanism; Fig. 7, a plan of the same; Fig. 8, a conventional elevation of the tapering mechanism; Fig. 9, an enlarged view of the shaft carrying the back gears; Fig. 10, a detail view; Fig. 11, a section of Fig. 10; Fig. 12, a detail section; Fig. 13, a descriptive view.

A represents the main frame; B, a shaft adapted to be connected to a source of power; C, a driving-shaft adapted to be belted to the shaft B and which drives a drill-spindle D.

G is a secondary frame, adapted to move relatively to the main frame and carrying the feeding mechanism, the lower end of the drill-spindle, and a traveling tool-carriage H.

I is a shaft driven from shaft C, adapted to drive the feeding mechanism; K, an arbor adapted through connecting mechanism to raise or lower the secondary frame relatively to the main frame; J, an arbor adapted through connecting mechanism to raise or lower the drill-spindle relatively to the secondary frame; L, a frame adapted to swing on the lower part of the main frame, carrying a revoluble face-plate M; N, a movable shaft driven from shaft C and by connecting-gearing adapted to rotate face-plate M.

The main frame of the machine consists of a base a, a main column a', and a secondary column a^2. The lower extremity of the secondary column a^2 is divided to form a fork adapted to support the shaft B, which carries a driving-pulley b and a speed-pulley b'. A curved arm a^3 extends from the column a' and carries a bearing a^4. On the opposite side of the column a^5 is an arm supporting a bearing a^6 in line with bearings a^4. Mounted in these bearings a^4 a^6 is a driving-shaft C, upon which is loosely mounted a sleeve c, having secured thereto a speed-pulley c' in line with the speed-pulley b'. The end of sleeve c nearest bearing a^4 is provided with clutch-teeth c^2, adapted to be engaged by a clutch c^3, feathered to the shaft C, and capable of longitudinal movement thereon. For sliding the clutch I provide a lever c^4, fulcrumed on the arm a^3 and connected to the clutch by means of a link and loose yoke. The end of sleeve c farthest from the bearing a^4 is provided with a gear c^5. Next to gear c^5 on shaft C is a bevel-pinion c^6, then a gear c^7 and a speed-pulley c^8. One end of the shaft is supported in a sleeve c^9 carried by the bearing a^6 and provided at its outer extremity with a beveled pinion c^{10}. The inner end is provided with a series of teeth adapted to be engaged by a clutch c^{11}, feathered to shaft C. Bevel-pinion c^{10} is adapted to engage with a corresponding pinion d, supported on a bearing a^8, and feathered to the drill-spindle D. Mounted in eccentric rings e in standards a^7 is a shaft E, adapted to be actuated by lever e' and carrying gears e^2 e^3, adapted to mesh with gears c^5 c^7. By partially rotating the eccentric-rings the gears e^2 e^3 may be thrown in or out of engagement with gears c^5 c^7. When the clutch c^3 is in engagement with sleeve c the speed-pulley c' and shaft C will rotate together. When clutch c^3 is disengaged from sleeve c the sleeve is free to rotate on the shaft. By throwing the gears e^2 e^3 into

engagement with gears c^5 c^7 the speed of the shaft, relatively to the speed of the sleeve, will be varied in accordance with the arrangement of the differential gearings e^2 e^3 c^5 c^7.

The drill-spindle D passes through bearing a^8, and its lower end is journaled in a sleeve F carried by the secondary frame G and movable relatively thereto. The sleeve F is provided with a rack-bar f, which engages with a pinion j, secured to an arbor J, mounted in suitable bearings on the secondary frame. By revolving the arbor the rack-bar is made to travel on the pinion j, and the sleeve F is raised or lowered. Loosely mounted on the arbor J is a gear j^2, secured to a worm-wheel j^3, also loosely mounted on arbor J, and provided on its outer side with clutch-teeth j^4. Pivotally secured to the outer end of arbor J is a lever j^5, provided at one end with clutch-teeth j^6, adapted to engage with clutch-teeth j^4. The opposite end is provided with an operating-handle j^7. By moving the handle toward the secondary frame the clutch-teeth j^6 are disengaged from clutch-teeth j^4, and the arbor J and worm-wheel j^3 are free to rotate independently of each other, but when the teeth are in engagement the two rotate together. An arbor K passes through suitable bearings in the secondary frame, adjacent to the main column a', and carries a pinion k adapted to engage with a rack-bar a^9 secured to the column a'. By rotating the arbor K the pinion k is made to travel on the rack-bar, and the secondary frame is raised or lowered on the main column. The outer end of the arbor is provided with a friction-clutch k', adapted to engage with a gear k^2 loosely mounted on the arbor K and in line with the gear j^2. By throwing the clutch k' into engagement with the gear k^2 the two will rotate together, but are free to rotate independently of each other when the clutch is disengaged. Gears g are mounted on an arm g', pivotally secured to the secondary frame and adapted to connect gears j^2 and k^2. By mounting the gears g on a pivoted arm it is possible to throw them into a position such that they connect with gears j^2 and k^2 or to throw them into a position out of engagement with these gears. The arbor K may thus be operated from arbor J, if required, or may be operated independently. A clamping-bolt g^8 passes through a slot in the arm g and into the secondary frame and holds the arm in any required position.

Mounted in a bracket o, secured to the main frame, is a shaft O, carrying a speed-pulley o', in line with the speed-pulley c^8, and a bevel-pinion o^2, adapted to mesh with bevel-pinions i i', loosely mounted on shaft I, one above and one below the axis of shaft O. The shaft I passes through suitable bearings in the bracket o. A clutch i^2 is feathered to the shaft I between the bevel-pinions i i and is adapted to engage with teeth on the inner faces of the bevel-pinions. When the clutch is moved longitudinally on the shaft I, so as to engage with the bevel-gear i, the shaft l will be rotated in one direction by rotating the shaft O, and by throwing the clutch into engagement with the bevel-pinion i' the shaft I will be rotated in the opposite direction. A lever o^3 is connected with the clutch i^2 by means of the ordinary loose yoke. The lower end of the shaft I is provided with a bevel-pinion i^3, adapted to engage with a similar pinion p, loosely mounted on a shaft P, provided with a worm p', adapted to engage with worm-wheel j^3. The outer end of shaft P is provided with a hand-wheel p^3. The hub of pinion p is provided with clutch-teeth p^4, adapted to engage with clutch p^5, secured to the shaft P. By disengaging the clutch from the bevel-gear the shaft and bevel-pinion are free to rotate independently of each other, but will rotate together when the clutch is in engagement with the beveled pinion. By rotating shaft I shaft P will be rotated, and through worm p' worm-wheel j^3 will be rotated. If clutch-teeth j^6 are in engagement with clutch j^4 the arbor J will rotate with the worm-wheel, and the sleeve F may be lowered or raised relatively to the secondary frame G by means of pinion j and rack-bar f. The speed-pulley o' is belted to speed-pulley c^8, and by rotating shaft C the spindle D may be raised or lowered, as the case may require. If gears g are thrown into engagement with gears j^2 and k^2, the arbor K may be rotated from shaft C and the secondary frame raised or lowered on the main column, as the case may be. By throwing the clutch-teeth j^6 out of engagement with clutch-teeth j^4 the secondary frame will be raised or lowered without moving the spindle relatively thereto.

Secured to the secondary frame G are ways g^5, adapted to support the traveling tool-carriage H. A T-slot h in the tool-carriage is adapted to support a tool-post and cutting-tool. A screw h', parallel with the ways, supports a nut h^2, secured to the traveling tool-carriage. The outer end of screws h' is provided with a gear h^3.

Rigidly secured to shaft P is a spiral gear p^6, adapted to engage with a spiral gear h^4, secured to a shaft h^5 parallel with screw h'. The opposite end of shaft h^5 is provided with a gear h^6, adapted to engage with gear h^3. By rotating the shaft P power will be transmitted through the spiral gears, shaft h^5, and gears h^6 h^3 to screw h', and the carriage H moved along the ways by means of the nut h^2.

For turning an inclined surface I provide mechanism consisting of an angular guide Q, pivotally mounted in a bracket a^{10}, secured to the main frame, a lever g^4, pivotally mounted in a bracket g^7, secured to the secondary frame G and slotted link g^6, pivotally secured to one arm of lever g^4 and adapted to be clamped to the traveling tool-carriage H by means of a bolt h^6. The opposite end of lever g^4 carries a roller g^9, adapted to travel in the angular guide Q. A slotted arc a^{11} is secured to bracket a^{10} and carries a series of graduations. The upper end of guide Q is provided

with an index adapted to register with these graduations. The guide may be tilted at any required angle and locked in position by means of a clamp-bearing a^{12}.

To feed the secondary frame downward and the tool-carriage at right angles thereto the nut h^2 is removed from the tool-carriage H and the link clamped thereto. The machine is started, and, by the mechanism hereinbefore described, the secondary frame is moved relatively to the main frame, the lever g^4 moves with the secondary frame, and the roller g^9 follows the angular guide, and the lever is moved on its pivot, thus sliding the tool-carriage on the ways. The face-plate M is pivoted on the frame L and is provided with a gear m on its under face, adapted to mesh with a gear a^{13}, mounted on the main column. The shaft N is mounted in a movable bearing a^{14} and carries a bevel-gear n, adapted to mesh with bevel-pinion c^6, and a gear n' on its lower end, adapted to mesh with gear a^{13}. By revolving shaft C power is transmitted to the face-plate through the gearing and shaft N. By lowering the bearing a^{14} the bevel-gear n' will be disengaged from bevel-pinion c^6, and the shaft C may be rotated without rotating the face-plate.

To clamp the face-plate into a position concentric with the axis of the spindle I provide a bracket l, extending from the frame L, having an aperture adapted to register with an aperture in the base of the main frame when the face-plate is concentric with the spindle. A bolt or pin l' passes through these apertures and prevents the frame from moving.

To explain the operation, assume that a pulley is to be drilled, bored, turned, and crowned. The pulley is clamped to the face-plate and a drill placed in the spindle D. The shaft N is lowered and the pinion n disengaged from c^6. The clutch c^{11} is thrown into engagement with the sleeve c^9 and the machine started. The spindle D will be revolved, and, by manipulating the feeding mechanism as described, the drill may be fed downward while rotating and the shaft-hole of the pulley drilled. If it is necessary to make a large shaft-hole, a boring-tool may be clamped either in the spindle or tool-carriage, the clutch c^{11} disengaged from sleeve c^9, the shaft N raised until bevel-pinion n engages bevel-pinion c^6, and the machine is started. The spindle does not rotate, but the face-plate carrying the pulley does. The spindle or secondary frame may be fed down in the same manner described and the shaft-hole bored to the required size. To face the edges of the flange and hub a turning-tool is clamped in the traveling tool-carriage. The clutch-teeth j^6 are disengaged from clutch-teeth j^4 and the tool-carriage is fed across the pulley, which is revolved. To turn and crown the pulley the tool-carriage is brought into a position where the tool will be in the proper relation to the face of the pulley, the nut h^2 is removed, the tapering mechanism set, and the clamping-bolt h^6 tightened upon the link g^6. The gears g are thrown into a position so as to connect gears j^2 and k^2, the friction-clutch k' is closed, and the machine started. The face-plate will rotate, the secondary frame fed downward and the tool-carriage slightly moved at right angles to the path of movement of the secondary frame, and the face of the pulley turned at the required angle, thus crowning the pulley-face. By throwing the clutch i^2 into engagement with the beveled pinion (not used in these described operations) the movable parts will be fed in a reverse direction. When it is necessary to drill big work, the frame L may be swung on column a' and the face-plate removed from beneath the spindle.

In Figs. 3, 6, and 7 a modified form of feeding mechanism is shown. The speed-pulleys c^8, o', shaft I, and gearing o^2 I I' are supplemented by a gear d', secured to the beveled gear d, a vertical shaft R passing through a suitable bearing on the main frame and having a gear r feathered thereto adapted to mesh with gear d'. The lower end of the shaft carries a crown-wheel r', having several series of cog-teeth r^2 at different radial distances from the center of shaft R. Mounted in suitable bearings, at right angles to the shaft R, is a shaft S, carrying at its free end a bevel-pinion s, adapted to engage with a bevel-pinion s', mounted on a shaft corresponding to the lower end of the shaft I. A gear s^2 is feathered to the shaft S beneath the crown-wheel. A forked arm s^3 takes around the gear s^2 and is adapted to slide the gear along the shaft and hold it in engagement with any required series of teeth on the crown-wheel r'. The speed of the shaft S, relatively to the speed of shaft R, will be varied according as the gear s^2 is in engagement with a series of crown-teeth nearer to or farther from the center of shaft R.

I claim as my invention—

1. The combination in a drilling machine of a main frame; a secondary frame movable thereon; a drill spindle carried by the secondary frame; a carriage adapted to carry a turning tool and movable relatively to the drill spindle; a revoluble face plate mounted on a frame adapted to swing about the main frame, below the secondary frame; means for rotating the spindle; means for moving the tool carriage, and means for moving the secondary frame; substantially as and for the purpose set forth.

2. The combination in a drilling machine of a main frame; a secondary frame movable thereon; a tool carriage movable transversely to the path of movement of the secondary frame; a drill spindle carried by the secondary frame; a revoluble face plate mounted on a frame adapted to swing about the main frame below the secondary frame; means for rotating the spindle; means for moving the secondary frame, means for moving the tool carriage, and means for locking the face plate

in a position having its center of rotation concentric with the center of rotation of the drill spindle, substantially as and for the purpose set forth.

3. The combination, in a drilling machine of a main frame, a secondary frame movable thereon, a tool carriage carried by the secondary frame and adapted to move transversely to its path of movement, a drill spindle carried by the secondary frame, means for moving the tool carriage, means for operating the spindle, secondary frame and tool carriage simultaneously, and means for disconnecting the tool carriage from the operating mechanism, substantially as and for the purpose set forth.

4. The combination, in a drilling machine of a main frame, a secondary frame movable thereon, a tool carriage carried by the secondary frame and adapted to move transversely to its path of movement, an arm pivoted to the secondary frame, carrying at one end a slotted link adapted to be secured to the tool carriage, and a roller at the other end adapted to move in a guide pivotally secured to the main frame, substantially as and for the purpose set forth.

5. The combination in a drilling machine of a main frame a secondary frame movable thereon; a tool carriage carried by the secondary frame and adapted to move transversely to the path of movement of the secondary frame; a drill spindle carried by the secondary frame and adapted to be driven from the main frame; a revoluble face plate carried by a bracket mounted on the main frame below the drill spindle; a gear secured to the face plate adapted to mesh with a gear supported on the main frame; a vertical shaft, carrying a pinion adapted to mesh with a pinion on a driving shaft, and a gear adapted to mesh with the gear mounted on the main frame; means for raising or lowering the shaft; means for rotating the spindle; means for moving the secondary frame, and means for moving the tool carriage, substantially as and for the purpose set forth.

6. The combination in a drilling machine of a main frame, a driving shaft carried thereby; a secondary frame adapted to move on the main frame; a drill spindle carried by a sleeve mounted in the secondary frame; a pinion on the driving shaft adapted to mesh with a pinion feathered to the drill spindle; a shaft driven from the driving shaft, carried by the secondary frame; a bevel pinion on its lower extremity adapted to engage with a pinion carried by a supplementary shaft having a worm, adapted to mesh with a worm wheel carried by an arbor; a pinion mounted on the arbor and adapted to mesh with a rack bar carried by the sleeve supporting the drill spindle; a traveling tool carriage carried by the secondary frame; and a connection between the supplementary shaft and tool carriage whereby the tool carriage may be moved on the secondary frame transversely to its path of movement, substantially as and for the purpose set forth.

7. The combination in a drilling machine of a main frame, a driving shaft carried thereby; a secondary frame adapted to move on the main frame; a drill spindle carried by a sleeve mounted in the secondary frame; a pinion on the driving shaft adapted to mesh with a pinion feathered to the drill spindle; a shaft, driven from the driving shaft, carried by the secondary frame; a bevel pinion on its lower extremity adapted to engage with a pinion carried by a supplementary shaft having a worm, adapted to mesh with a worm wheel carried by an arbor; a pinion mounted on the arbor and adapted to mesh with a rack bar carried by the sleeve supporting the drill spindle; a traveling tool carriage carried by the secondary frame; a spiral gear mounted on the shaft carrying the worm, adapted to mesh with a spiral gear carried by a shaft adapted, through connecting gearing, to drive a feed screw operating the tool carriage, substantially as and for the purpose set forth.

8. In a drilling machine the combination of a main frame; a driving shaft carried thereby; a secondary frame adapted to move on the main frame; a drill spindle carried by a sleeve mounted in the secondary frame; a pinion on the driving shaft adapted to mesh with a pinion feathered to the drill spindle, a shaft driven from the driving shaft and carried by the secondary frame; a bevel pinion on its lower extremity adapted to engage with a pinion carried by a supplementary shaft having a worm adapted to mesh with a worm wheel carried by an arbor; a pinion mounted on the arbor and adapted to mesh with a rack bar carried by the sleeve supporting the drill spindle; a traveling tool carriage carried by the secondary frame; and a connection between the supplementary shaft and tool carriage whereby the tool carriage may be moved on the secondary frame transversely to its path of movement; a revoluble face plate mounted on a swinging frame, and a vertical shaft driven from the driving shaft adapted, through connecting mechanism, to rotate the face plate, substantially as and for the purpose set forth.

9. The combination in a drilling machine of a main frame, a driving shaft carried thereby; a secondary frame adapted to move on the main frame; a sleeve mounted on the secondary frame; a drill spindle carried thereby; a pinion on the driving shaft adapted to mesh with a pinion feathered to the drill spindle; a shaft driven from the driving shaft and carried by the secondary frame; a bevel pinion on its lower extremity adapted to engage with a pinion carried by a supplementary shaft having a worm adapted to mesh with a worm wheel carried by an arbor; a pinion mounted on the arbor and adapted to mesh with a rack bar carried by the sleeve supporting the drill spindle; an arbor mounted on the secondary frame adjacent to the main frame; a pinion

on the arbor adapted to engage with a rack bar secured to the main frame; a gear loosely mounted on the arbor and in line with a gear mounted on the arbor which actuates the sleeve carrying the drill spindle; a clutch adapted to lock the gear to the arbor and a train of gears mounted on a pivoted arm, adapted to mesh with the gears on the arbors, and form a driving connection between them; a traveling tool carriage carried by the secondary frame; a connection between the supplementary shaft and tool carriage whereby the tool carriage may be moved on the secondary frame transversely to its path of movement; a revoluble face plate mounted on a swinging frame; a shaft driven from the driving shaft and adapted, through connecting mechanism, to rotate the face plate, substantially as and for the purpose set forth.

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