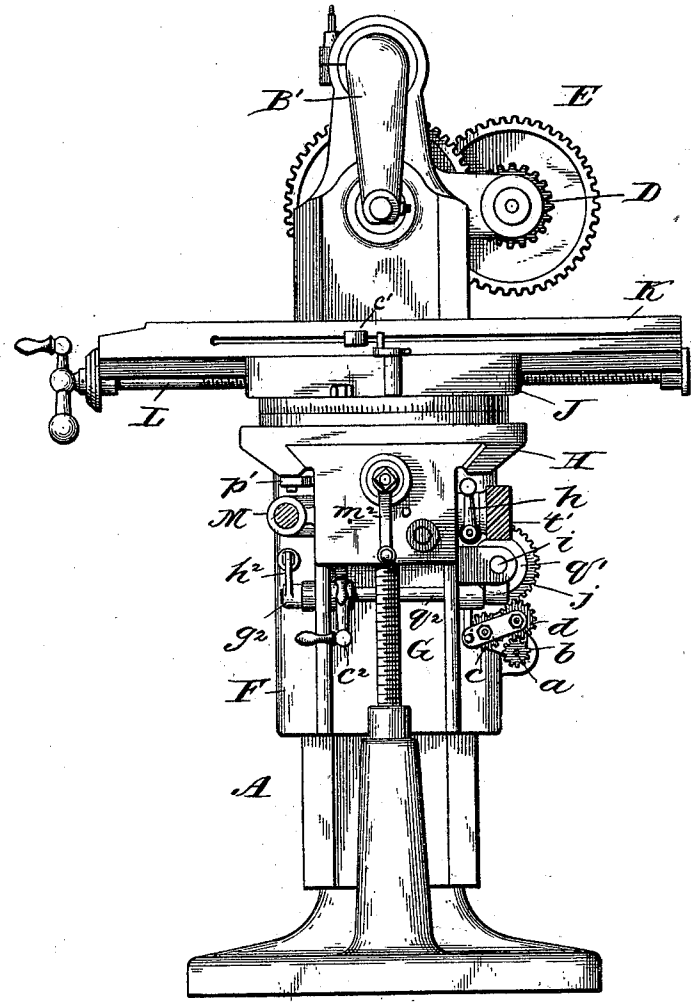
(No Model.) 8 Sheets—Sheet 1.

F. HOLZ.

MILLING MACHINE.

No. 554,422. Patented Feb. 11, 1896.

Fig. 1.



Witnesses.
J. Thomson Cross.
Bernard J. Mansfeld

Inventor
Frederick Holz
by Chas. M. Cook
his Attorney.

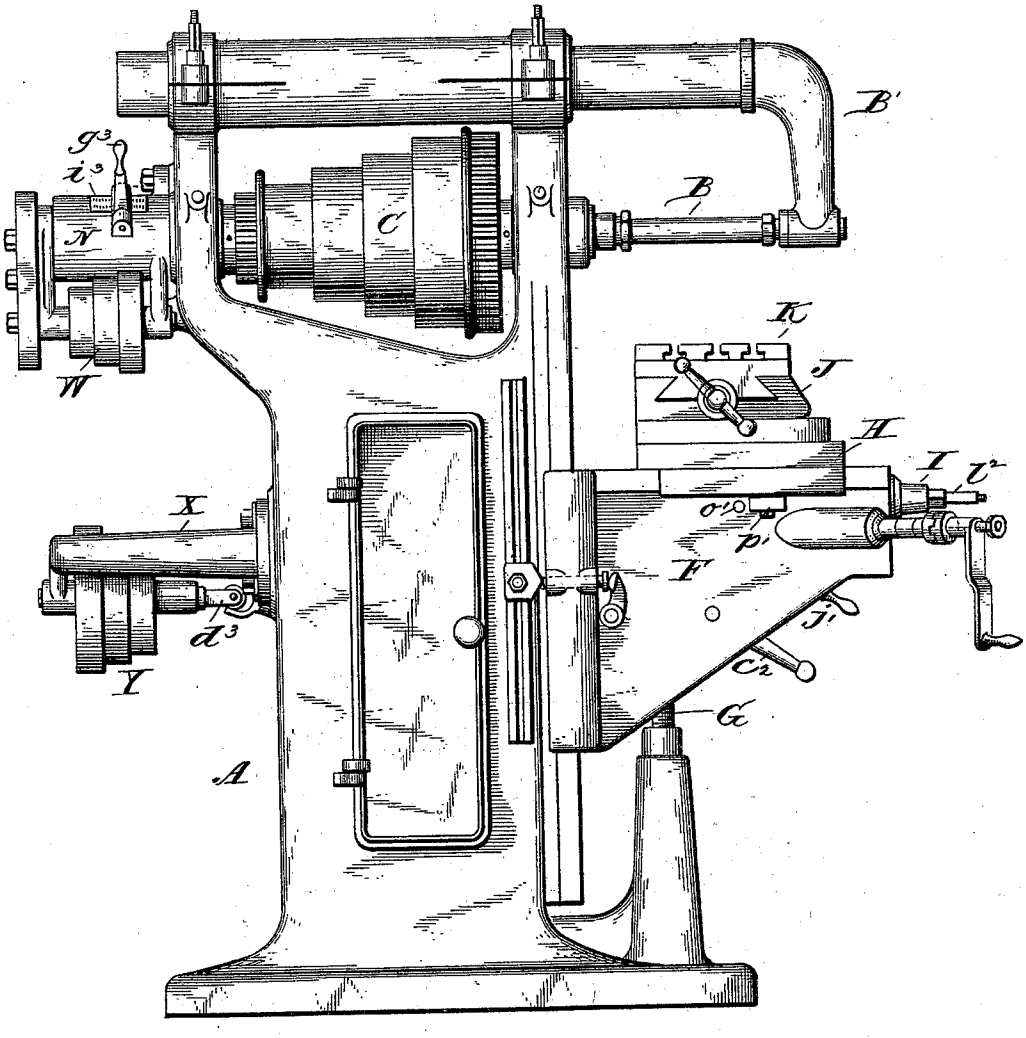
(No Model.) 8 Sheets—Sheet 2.

F. HOLZ.

MILLING MACHINE.

No. 554,422. Patented Feb. 11, 1896.

Fig. 2.



Witnesses.
J. Thomson Cross
Bernard J. Hausfeld

Inventor:
Frederick Holz
by Chas. M. Cook
his Attorney.

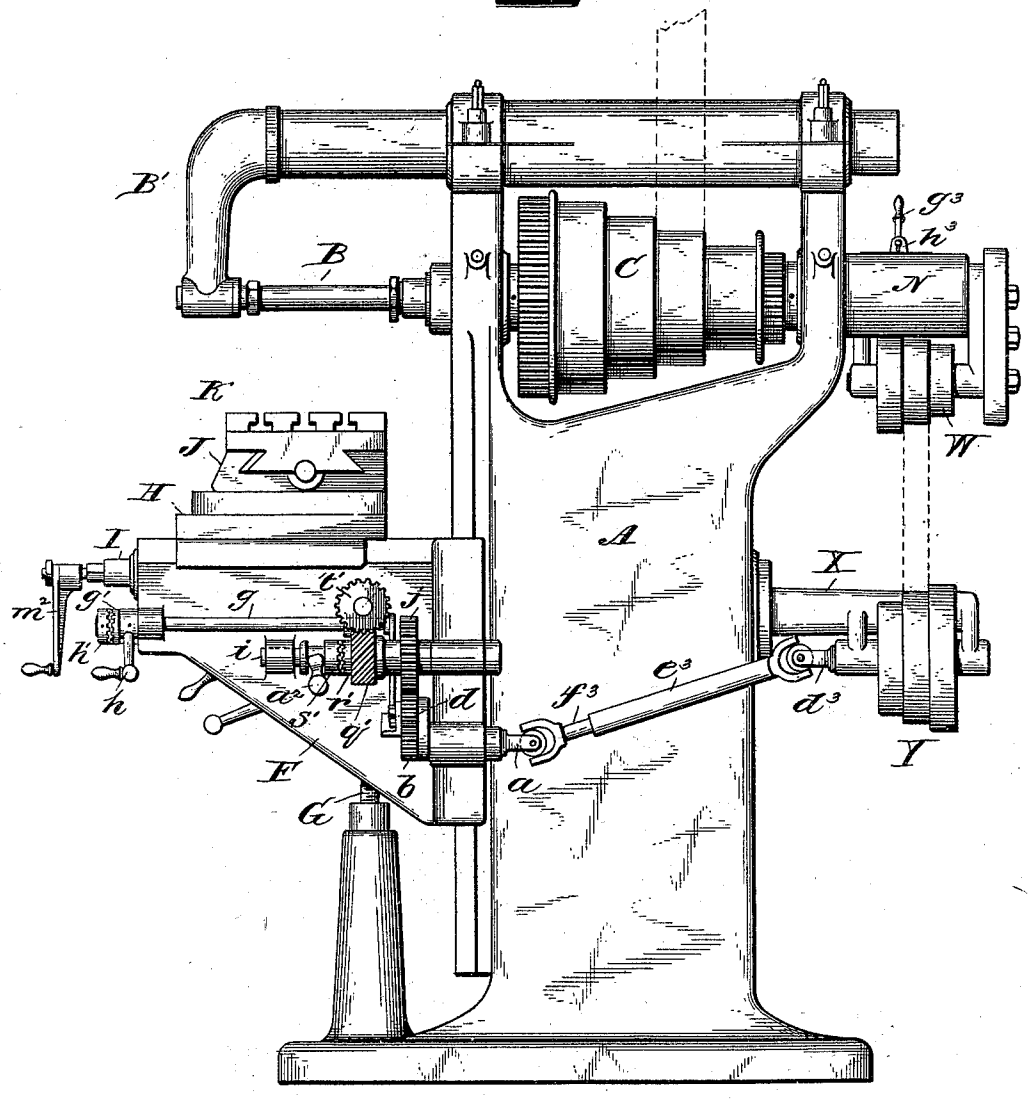
(No Model.) 8 Sheets—Sheet 3.

F. HOLZ.

MILLING MACHINE.

No. 554,422. Patented Feb. 11, 1896.

Fig. 3.



Witnesses.

J. Thomson Cross

Bernard J. Mansfeld.

Inventor

Frederick Holz

by Chas. M. Beck

his Attorney.

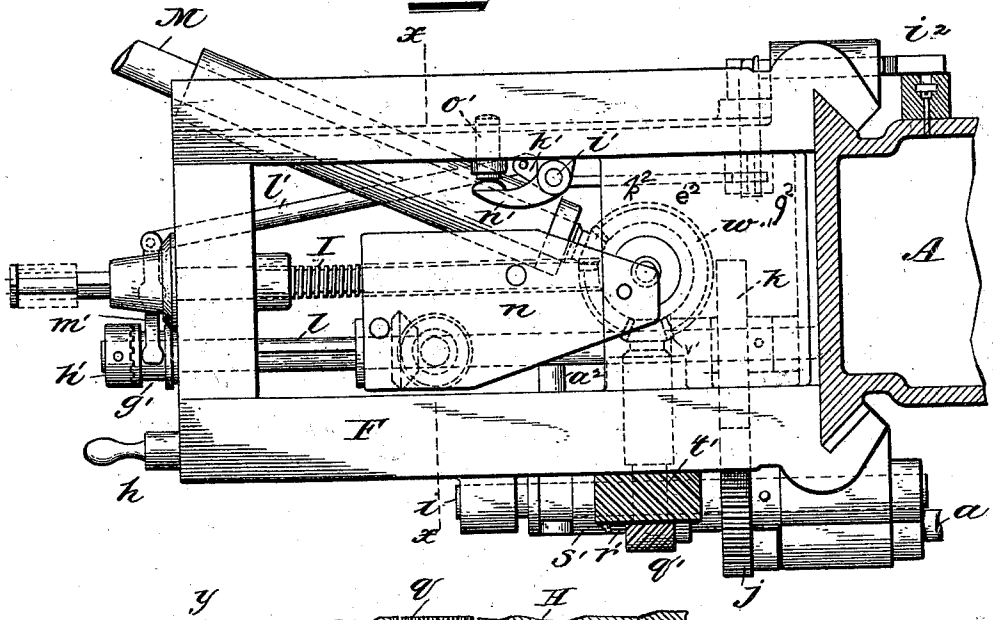
(No Model.) 8 Sheets—Sheet 4.

F. HOLZ.

MILLING MACHINE.

No. 554,422. Patented Feb. 11, 1896.

Fig. 4.



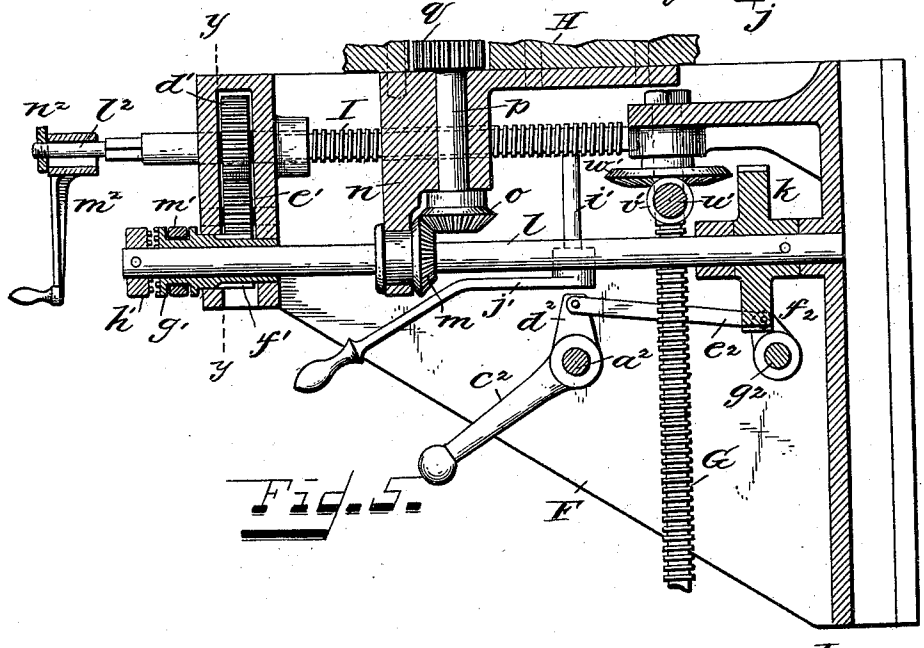


Fig. 5.

Witnesses.

J. Thomson Cross

Bernard J. Hausfeld.

Inventor.

Frederick Holz

by Chas. M. Cook

his Attorney.

(No Model.) 8 Sheets—Sheet 5.

F. HOLZ.

MILLING MACHINE.

No. 554,422. Patented Feb. 11, 1896.

Fig. 6.

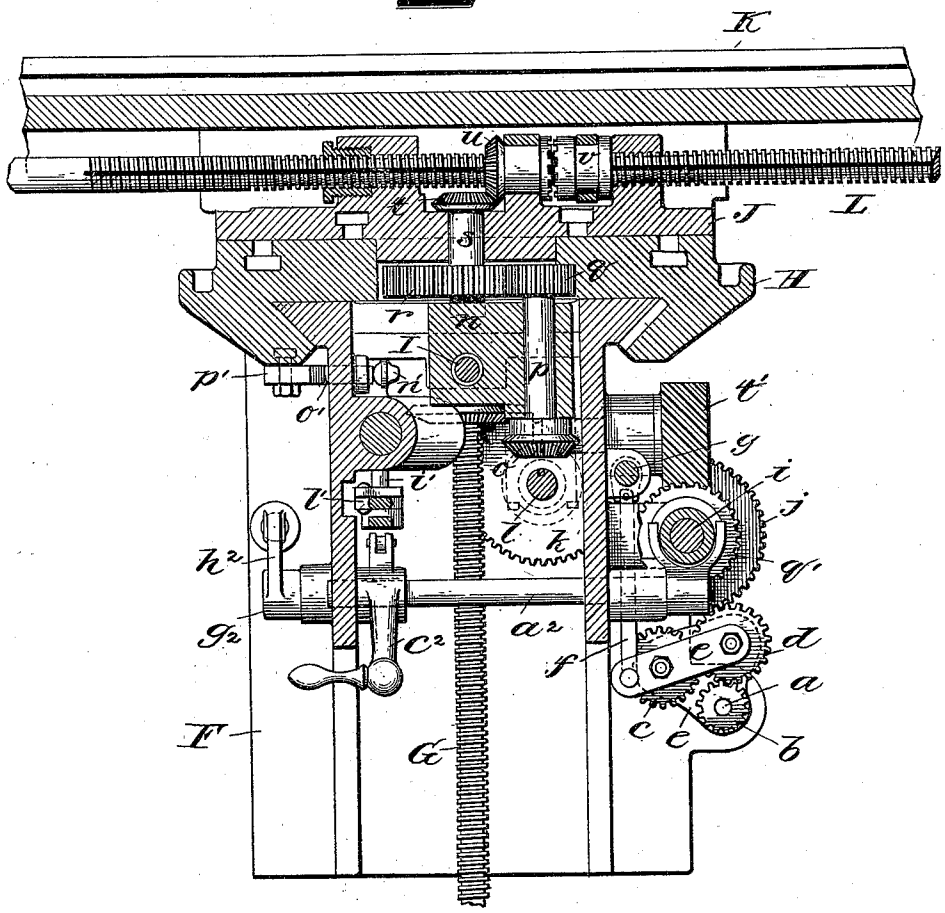
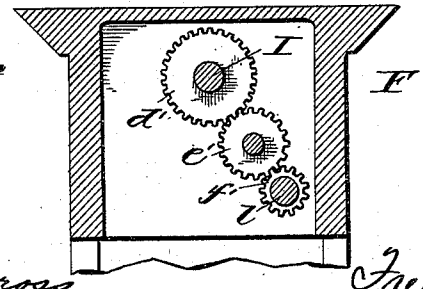


Fig. 7.



Witnesses.
J. Thomson Cross.
Bernard J. Haufeld

Inventor.
Frederick Holz
by Chas. M. Cook
his Attorney.

(No Model.)

8 Sheets—Sheet 6.

F. HOLZ.

MILLING MACHINE.

No. 554,422. Patented Feb. 11, 1896.

Fig. 8.

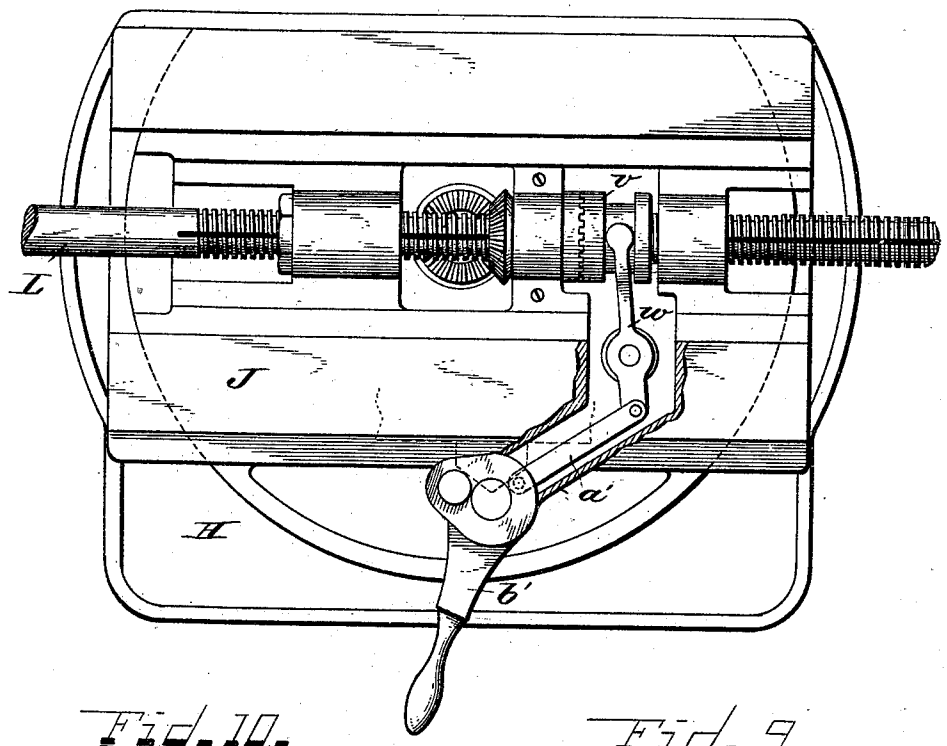


Fig. 10.

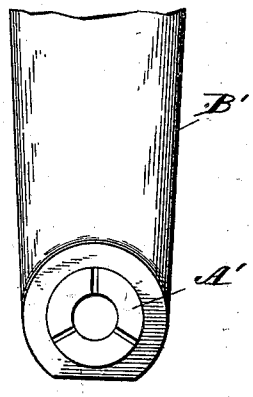
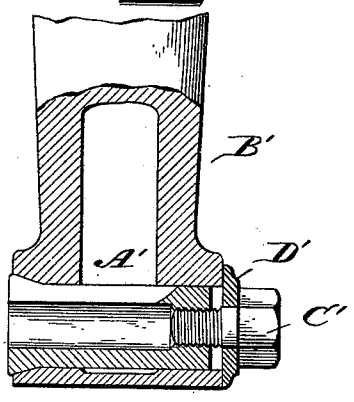


Fig. 9.



Witnesses.
J. Thomson Cross.
Bernard J. Hausfeld.

Inventor
Frederick Holz
by Chas. M. Peck
his Attorney.

(No Model.)

8 Sheets—Sheet 7.

F. HOLZ.

MILLING MACHINE.

No. 554,422. Patented Feb. 11, 1896.

Fig. 11.

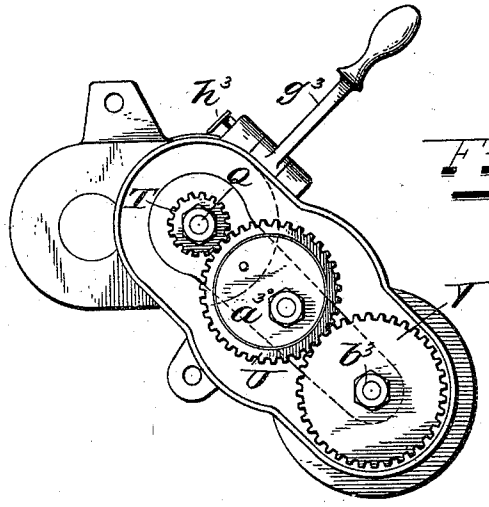


Fig. 12.

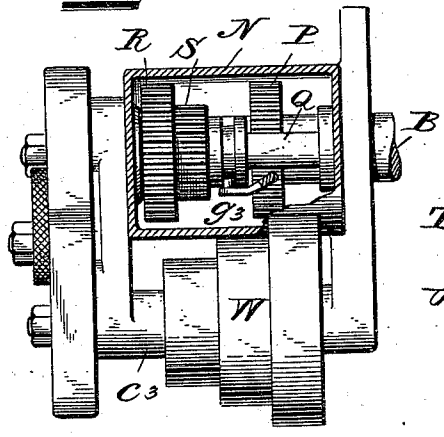


Fig. 13.

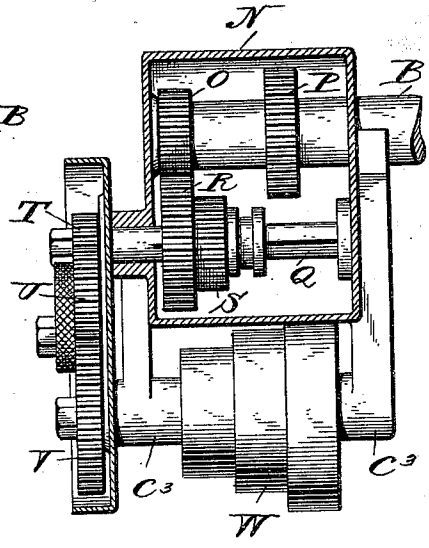
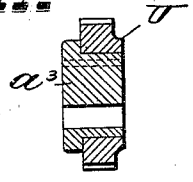


Fig. 14.



Witnesses.

J. Thomson Cross

Bernard J. Hausfeld.

Inventor.

Frederick Holz

by Chas. M. Cox

his Attorney.

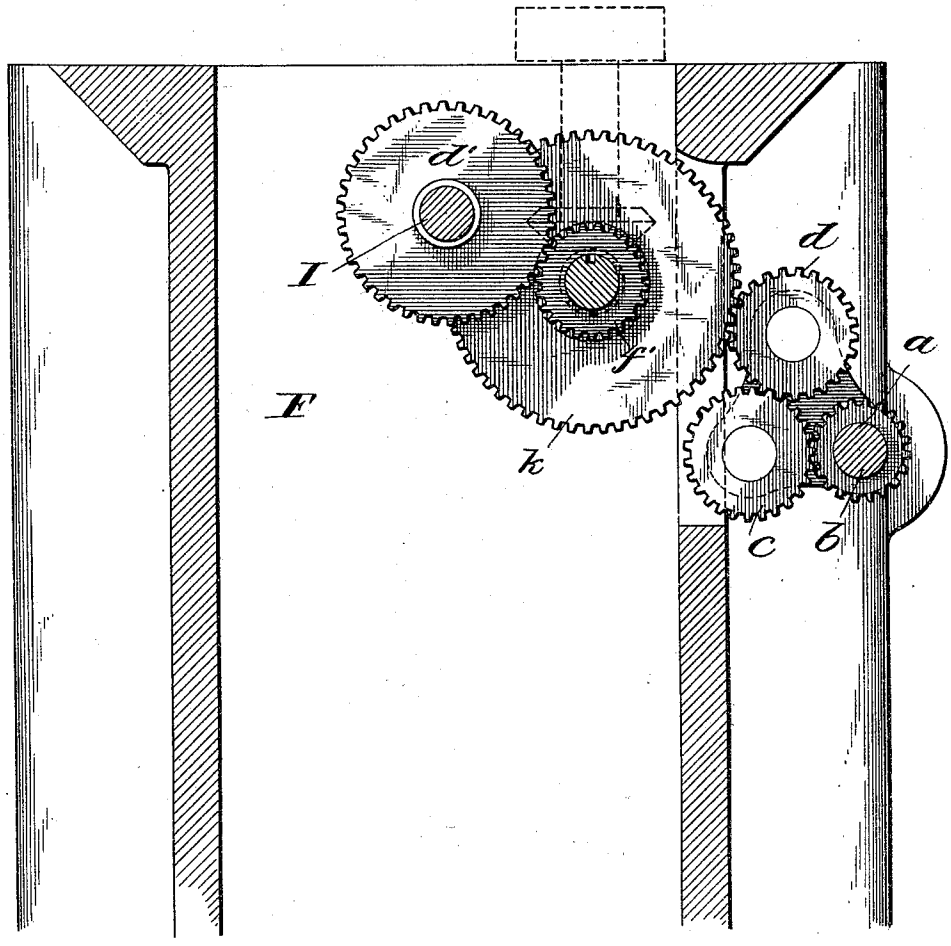
(No Model.) 8 Sheets—Sheet 8.

F. HOLZ.

MILLING MACHINE.

No. 554,422. Patented Feb. 11, 1896.

Fig. 15.



Witnesses.
J. Thomson Cross.
Bernard J. Mansfield.

Inventor.
Frederick Holz
by Chas. M. Beck
his Attorney.

UNITED STATES PATENT OFFICE.

FREDERICK HOLZ, OF CINCINNATI, OHIO, ASSIGNOR TO THE CINCINNATI MILLING MACHINE COMPANY, OF SAME PLACE.

MILLING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 554,422, dated February 11, 1896.

Application filed October 1, 1894. Serial No. 524,604. (No model.)

To all whom it may concern:

Be it known that I, FREDERICK HOLZ, a citizen of the United States, residing at Cincinnati, in the county of Hamilton and State of Ohio, have invented certain new and useful Improvements in Milling-Machines, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification.

My invention relates to that class of machines known as "universal milling-machines," wherein the work-carrying table has all of the movements common to such machines; and its object is to improve the construction and efficiency of this class of machines and to render the stopping of any and all of the movements of the work-carrying table automatic when desired, and to give the feed mechanism the speed required and to change the speed thereof without stopping the same.

The novelty of my invention will be hereinafter set forth, and specifically pointed out in the claims.

In the accompanying drawings, Figure 1, Sheet 1, is a front elevation of a milling-machine embodying my invention. Fig. 2, Sheet 2, is a side elevation of the same from the left of Fig. 1. Fig. 3, Sheet 3, is a side elevation of the same from the right of Fig. 1. Fig. 4, Sheet 4, is an enlarged plan view of the knee and the parts thereon below the saddle. Fig. 5, Sheet 4, is a side elevation of Fig. 4. Fig. 6, Sheet 5, is a sectional front elevation of the knee, saddle, housing, work-carrying table, and operating mechanism therefor on the dotted line *x x* of Fig. 4. Fig. 7, Sheet 5, is a front section on the dotted line *y y* of Fig. 5. Fig. 8, Sheet 6, is a plan view, partly in section, of the monitor-housing with the work-carrying table removed. Fig. 9, Sheet 6, is an enlarged sectional side elevation of the outer end of the arm in which the tool-arbor is journaled. Fig. 10, Sheet 6, is a rear view of Fig. 9, looking from the left. Fig. 11, Sheet 7, is an enlarged rear elevation of the shifting mechanism. Fig. 12, Sheet 7, is a side elevation of the same, partly in section, from the right of Fig. 11. Fig. 13, Sheet 7, is a plan view of the same, partly in section. Fig. 14, Sheet 7, is a transverse section of the intermediate gear of Fig. 11. Fig. 15, Sheet 8, is a diagrammatic view from the front of the knee representing a modification.

The same letters of reference are used to indicate identical parts in all the figures.

Referring to Figs. 1, 2, and 3 in the general description of the machine, which may be of the usual or any suitable construction, it is only necessary to say that A is the frame or standard, B the cutter-arbor or live spindle journaled therein and driven by the usual cone-pulley C, with or without counter-shaft D and back-gearing E, as desired. On the front of the upright A is dovetailed the usual or any suitable knee F, which is given vertical movement by a screw G, operated either by hand or automatically by the machine, as hereinafter explained.

Dovetailed on the knee is the saddle H with horizontal movement to and from the standard A by means of a screw I, Figs. 4 and 5, operated either by hand or automatically by the machine, as hereinafter explained. Swiveled on the saddle and adjustable on its axis thereon is the monitor-housing J, to which is dovetailed the work-carrying table K. These parts with the exceptions to be hereinafter pointed out, may be, and preferably are, of the construction shown and described in my prior patent, No. 513,683 of January 30, 1894, in which, however, provision was made only for the feeding of the work-carrying table automatically and for its automatic stoppage, the adjustments of the knee and saddle being by hand alone.

My present machine, in addition to the independent hand adjustment and feeding of the work-carrying table, the saddle, and the knee, has an automatic feed for each of these parts, any one, two or all of which may be operated at one time and may be automatically stopped. In describing the mechanism for accomplishing this reference is made particularly to Figs. 4, 5, 6, 7 and 8.

In Figs. 1, 3, 4, and 6, *a* is a horizontal stub-shaft journaled in the knee and constantly driven by the machine by mechanism hereinafter to be explained. Fast on the forward end of this shaft is a pinion *b* meshing constantly with one of a pair of intermeshing

pinions *c d* journaled on a shifting plate or frame *e* hung concentric with the axis of the pinion *b* and actuated by a pivoted link *f*, whose upper end is pivoted to a crank-arm on a horizontal rock-shaft *g*, journaled at the side of the knee and extending forward and provided with an operating-handle *h* at its forward end, as seen more particularly in Fig. 3. Just above the pinions *c d* is journaled to the side of the knee a short horizontal shaft *i* having fast thereon a gear *j* with which either the pinion *c* or the pinion *d* is made to mesh by shifting the frame *e*. The gear *j* constantly meshes with a gear *k* within the frame of the knee and fast on a horizontal shaft *l* journaled therein and extending forward and projecting from the front of the knee. Feathered on the shaft *l* is the bevel-pinion *m* journaled in and carried by a pendent nut-piece or housing *n* secured to the under side of the saddle. The gear *m* meshes with a bevel-gear *o* fast on the lower end of a vertical shaft *p* journaled in the piece *n*, and whose upper projecting end has fast thereon in a cavity in the saddle a pinion *q*, Figs. 5 and 6, which meshes with a larger pinion or gear *r*, fast on the lower end of a vertical shaft *s*, journaled in the monitor-housing J, and whose upper end carries a bevel-pinion *t* meshing with a similar pinion *u*, journaled loosely on the screw feed-shaft L of the work-carrying table. The pinion *u* is journaled in the monitor-housing and carries one half of a clutch with which the other half of a clutch *v* feathered on the shaft L is engaged or disengaged by the forked arm *w*, link *a'*, and hand-lever *b'*, as shown in Fig. 8, and is described at length in my prior patent above referred to, both for stopping and starting the feed of the work-carrying table by hand or for stopping the feed automatically at any predetermined point by an adjustable wiper-block *c'*, Fig. 1, carried by the table K and for engaging and shifting the lever *b'* to disengage the clutch *v*.

It will be seen from the foregoing that the work-carrying table is automatically fed by the machine from the shaft *a*, and by shifting the frame *e* to cause either the pinion *c* or the pinion *d* to mesh with gear *j*, the direction of feed can be controlled and reversed at will.

To automatically feed the saddle toward or from the standard or column of the machine, I secure upon the screw I, in a cavity at the front of the knee, a pinion *d'*, Figs. 5 and 7, which meshes with an intermediate idle-pinion *e'* in said cavity, which latter pinion meshes with a pinion *f'* loose on the shaft *l*, but carrying one half of a clutch, *g'*, that can be engaged or disengaged from the other half, *h'*, of the clutch fast on the end of the shaft *l*, as seen in Figs. 4 and 5. As the shaft I passes through and its screw engages the piece *n* the saddle is moved in or out by the revolution of the shaft I whenever the clutch-faces *g' h'* are engaged. When they are disengaged by sliding half-clutch, *g'*, inward pinion *f'* is loose on the shaft *l* and does not impart motion to shaft I, as will be readily understood. To actuate half-clutch *g'*, I provide a vertical shaft *i'*, Figs. 4 and 5, journaled upon the inner side of the knee and having thereon a handpiece *j'* by which the shaft can be oscillated or rocked by hand. It also has fast on it a crank-arm *k'*, Fig. 4, from which a pivoted link *l'* extends forward and is pivoted to a pivoted fork-arm *m'* whose fork engages a circumferential groove in the half-clutch *g'* in such manner that the rocking of the shaft *i'* engages or disengages the clutch *g' h'*, as will be readily understood. To automatically rock the shaft *i'* to disengage the clutch and stop the in or out feed of the saddle, I provide a crank-arm *n'* fast on the upper end of shaft *i'* and which engages a plunger-piece *o'* projecting through a bore in the side of the knee with its outer end in the path of a wiper-block *p'* adjustably secured by a bolt in a T-slot on the under side of the saddle in such manner that when the wiper-block is brought in contact with the plunger *o'* it presses it in and thereby rocks the shaft *i'* and disengages clutch *g'* and stops the feed of the saddle, as will be readily understood.

To automatically feed the knee up or down and to stop the feed of the same, I provide a spiral or worm gear *q'*, Figs. 3 and 4, loose on the shaft *i* by the side of the gear *j* and carrying one half of a clutch *r'* with which the other half of the clutch *s'* feathered on the shaft *i* is made to engage or disengage by hand or be disengaged automatically. The gear *q'* meshes with a similar gear *l'* above it at right angles and fast on a shaft *n'* journaled through the side of the knee and having fast upon its inner end a small bevel-pinion *v'*, Figs. 4 and 5, meshing with a bevel-gear *w'* fast on the upper end of the screw-shaft G. Thus, when the half-clutches *r' s'* are engaged, the knee is automatically fed up or down by the machine, according to whether the pinion *c* or the pinion *d* is in mesh with gear *j*, as will be readily understood.

To slide the clutch *s'* to effect its engagement or disengagement, I provide a rock-shaft a^2 journaled across the knee below and at right angles to the shaft *l*, and having fast upon its end a fork b^2 engaging a circumferential slot in the clutch *s'* and provided with a hand-piece c^2 for rocking it to engage or disengage the clutch by hand. To disengage the clutch automatically, I provide on the opposite end of the shaft a^2 a crank-arm d^2, from which a pivoted link e^2, Fig. 5, extends to a crank-arm f^2 on a stub-shaft g^2 journaled through the side of the knee and carrying on its outer end a crank-arm or tappet h^2, Fig. 6, engaging a plunger i^2 extending through a bore in the knee and in the path of a wiper-block j^2, Figs. 2 and 4, adjustable by a bolt in a vertical T-slot in the side of the standard, the arrangement being such that when the plunger is engaged by the wiper-block in the up or down travel of the knee the shaft a^2 is rocked and the clutch *s'* disengaged from the

clutch r', thereby stopping the feed of the knee at any predetermined point.

It will be seen from the foregoing description and from the construction of the machine that the knee and saddle may remain stationary and the work-carrying table may be automatically fed first in one direction and then in the opposite direction and can be automatically stopped at any point; also that the work-carrying table may remain fixed with reference to the housing and the knee may be stationary and the saddle may be automatically fed first in one direction and then in the opposite direction and can be automatically stopped at any point; also that the work-carrying table and housing and saddle may remain fixed with reference to each other, and the knee may be automatically fed first in one direction and then in the opposite direction and can be stopped at any point; also that any two or all of the above parts may be simultaneously and automatically fed and stopped at the will of the operator.

The screw-shafts I and L are each provided with hand-operating handles for adjusting or feeding by hand, when desired, and I provide the usual hand-shaft M, having on its inner end a bevel-gear k^2 meshing with gear w' for operating screw-shaft G by hand when desired to adjust or feed the knee.

To prevent annoyance and possible injury to the attendant when the machine is being operated automatically, I provide cylindrical extensions l^2, Figs. 3, 4, and 5, from the squared parts of the screw-shafts engaged by the handles m^2 in turning the same, so that when said shafts are turning automatically the handles can be withdrawn from the squared parts and will hang loose without turning on the parts l^2, whose outer ends have nuts n^2 to prevent the accidental removal of the handles, as will be readily understood.

In some machines where the automatic feeding of the knee is not desired the construction may be simplified, as represented by the diagram Fig. 15, where all of the other features of the machine are preserved, except the automatic feeding of the knee. Here the shaft i and the parts carried thereby, as well as the shaft a^2 and its actuating parts, are dispensed with, and the gears c d on the frame e are made to (either of them) engage with gear k, as shown, the rest of the machine being constructed and operated as before described.

Another feature of my invention (illustrated in Figs. 2, 3, 11, 12, 13 and 14) relates to mechanism for changing the speed of the shaft a, and consequently all of the automatic feeds, by the attendant without stopping the machine or stopping the feed. I accomplish this by the following means.

On the rear end of the live-spindle, which projects beyond the rear upright of the standard A, are made fast, within a box or housing N, a small pinion O and a larger pinion P, Fig. 13. Journaled within the box N, parallel to the spindle B, is a counter-shaft Q, on which are feathered two pinions R S, the former to mesh with the pinion O, and the latter with the pinion P, though but two of them can be brought into mesh at the same time—that is to say, when the pinion R meshes with the pinion O the pinion S is out of the path of the pinion P, and when the pinion S meshes with the pinion P the pinion R is out of mesh with the pinion O. The pinions R S are side by side, and the distance between the pinions O P is such that the pinions R S can be shifted between them without either of them being in mesh, thereby stopping the revolution of the counter-shaft Q and the feed of the machine. On the rear projecting end of the shaft Q is a pinion T, Figs. 11 and 13, which meshes with an intermediate idle-pinion U, journaled on an eccentrically-secured hub a^3. The pinion U meshes with a pinion V fast on the counter-shaft b^3 in journals c^3 outside of the box N and carrying a cone-pulley W. Journaled in a bracket X projecting from the rear of the standard A is a shaft d^3 carrying a cone-pulley Y, Fig. 3, which is belted to the cone-pulley W. Connected by a gimbal-joint to the shaft d^3 is a tubular shaft e^3, in which is feathered and telescopically fits a shaft f^3 connected by a gimbal-joint to the shaft a. In this manner, as will be readily understood, the revolution of the live-spindle B is transferred to the shaft a to produce the automatic feeds hereinbefore described. By shifting the belt connecting the cone-pulleys W and Y the speed of the shaft a can be regulated; but to change the speed without requiring the shifting of the belt and without stopping the feed I provide a forked pivoted shifter-handle g^3, whose fork engages a circumferential groove in the hub of the gears R S, and by oscillating which said gears are shifted to engage R with O or S with P or to disengage both to stop the feed, as will be readily understood.

A pointer h^3 carried by the handle g^3 acting in connection with a fixed index-plate i^3, Fig. 2, enables the attendant or the foreman of the shop to see at a glance at just what speed the feed is working. Another combination of rates of speed may be quickly effected by placing gear T, Fig. 11, on shaft b^3 and gear V on shaft Q, and then turning the eccentric hub a^3 so as to cause the gear U to mesh with the gears V T in their changed positions. I have so arranged all of the operating handpieces that the attendant standing to the left of and about in line with the work-carrying table can reach all of them without shifting his position or removing his glance from the work being done, and thus can have perfect control of the machine.

The final feature of my invention (illustrated in Figs. 9 and 10) consists in providing a slotted tapering bushing A′, in which is journaled the outer end of the cutter-arbor and which is confined in a bore in the overhanging arm B′. By means of a bolt C′

passed through a washer D′ and engaging the bushing A′ the latter can be drawn in and compressed to snugly fit the arbor and take up any wear.

The work is carried on the table in the usual or any suitable manner, and the latter may be provided with a universal indexing and dividing head and the tail-stock of my prior patent, No. 432,621, of July 22, 1890.

Having thus fully described my invention, I claim—

1. In a milling-machine, the combination with a vertically-movable supporting-knee, of a screw-shaft for actuating the same, a driving-gear therefor, carried by the knee, driving mechanism co-operating with said screw-shaft and driving-gear; and shiftable, reversing, connecting mechanism, carried by the knee and placed intermediate said driving-gear and driving mechanism whereby the knee is raised and lowered automatically, substantially as described.

2. In a milling-machine, the combination with a vertically-movable supporting-knee, of a screw-shaft for actuating the same, a driving-gear therefor, carried by the knee, driving mechanism co-operating with said screw-shaft and driving-gear; and shiftable, reversing, connecting mechanism, carried by the knee and placed intermediate said driving-gear and driving mechanism whereby the knee is raised and lowered automatically, and automatic disconnecting mechanism for stopping the movement of the knee at any predetermined point, substantially as described.

3. In a milling-machine, the combination with a supporting-knee, of a saddle horizontally movable thereon, a screw-shaft for actuating the saddle, a driving-gear therefor carried by the knee, driving mechanism co-operating with said screw-shaft and driving-gear; and shiftable, reversing, connecting mechanism, carried by the knee and placed intermediate said driving-gear and driving mechanism, whereby the saddle is automatically fed in and out, substantially as described.

4. In a milling-machine, the combination with a supporting-knee, of a saddle horizontally movable thereon, a screw-shaft for actuating the saddle, a driving-gear therefor carried by the knee, driving mechanism co-operating with said screw-shaft and driving-gear; and shiftable, reversing, connecting mechanism, carried by the knee and placed intermediate said driving-gear and driving mechanism, whereby the saddle is automatically fed in and out, and automatic disconnecting mechanism for stopping the movement of the saddle at any predetermined point, substantially as described.

5. In a milling-machine, the combination with a supporting-knee, of a saddle carried thereby, a work-carrying table mounted on said saddle, feed mechanism for said table, a driving-gear therefor carried by the knee, driving mechanism co-operating with said driving-gear and feed mechanism; and shiftable, reversing, connecting mechanism carried by the knee and placed intermediate said driving-gear and driving mechanism, whereby the work-carrying table is automatically fed forward and backward, substantially as described.

6. In a milling-machine, the combination with a supporting-knee, of a saddle carried thereby, a work-carrying table mounted on said saddle, feed mechanism for said table, a driving-gear therefor carried by the knee, driving mechanism co-operating with said driving-gear and feed mechanism; shiftable, reversing, connecting mechanism carried by the knee and placed intermediate said driving-gear and driving mechanism, whereby the work-carrying table is automatically fed forward and backward; detachable connecting mechanism between said driving-gear and feed mechanisms, whereby the work-carrying table, saddle, and knee can be given simultaneous or independent automatic movement, and automatic disconnecting mechanism for stopping the movement of table, saddle, and knee at any predetermined point, substantially as described.

7. In a milling-machine, the combination with the feed driving-gear, as *b*, of a live-spindle having fast thereon two different-sized pinions, as O and P, a counter-shaft having feathered thereon two shiftable pinions R and S, an index-handle for shifting the latter pinions, and connecting mechanism between the counter-shaft and feed driving-gear, whereby the speed of the feed can be varied without stopping the machine, substantially as described.

8. In a milling-machine, the combination with a feed driving-gear, as *b*, of a live-spindle having thereon two different-sized pinions, as O and P, a counter-shaft having feathered thereon two shiftable pinions, as R and S, an index-handle for shifting the latter pinions, intermeshing and changeable gears, as T, U, V, driven by the counter-shaft, a cone-pulley, as W, belted to a cone-pulley as Y, and self-adjustable driving connections between the cone-pulley Y and gear *b*, substantially as described.

9. In a milling-machine, the combination with the knee and its feeding screw-shaft, the gear q' driven by the machine for operating the screw-shaft, clutch r' s' for said gear q', rock-shaft a^2 with fork engaging said clutch, handle c^2 for said rock-shaft, a wiper-block adjustable on the standard A, and connections between said shaft a^2 and wiper-block, whereby the latter rocks the shaft at any predetermined point to disconnect the clutch and stop the feed of the knee, substantially as described.

10. In a milling-machine, the combination of the saddle, the piece *n* carried thereby, the saddle feed-shaft I engaging piece *n*, gear d' on shaft I, gear f', clutch g' h' for gear f', rock-shaft i', with hand-piece *i* and connections to said clutch, wiper-block adjustable

on the saddle, and connections between said shaft i' and wiper-block, whereby the latter rocks the shaft at any predetermined point to disconnect the clutch and stop the feed of the saddle, substantially as described.

11. In a milling-machine, the combination with a feed screw-shaft, of an operating-handle mounted so as to slide freely thereon and provided with an angular-shaped opening through which the shaft passes, said shaft having an angular portion which fits closely the angular-shaped opening in said handle and a reduced portion adjacent to said angular portion on which said handle will hang idly when the shaft is being automatically fed, substantially as described.

FREDERICK HOLZ.

Witnesses:
J. THOMSON CROSS,
BERNARD J. HAUSFELD.