(No Model.)

4 Sheets—Sheet 1.

F. O. FARWELL.

MILLING MACHINE.

No. 596,491. Patented Jan. 4, 1898.

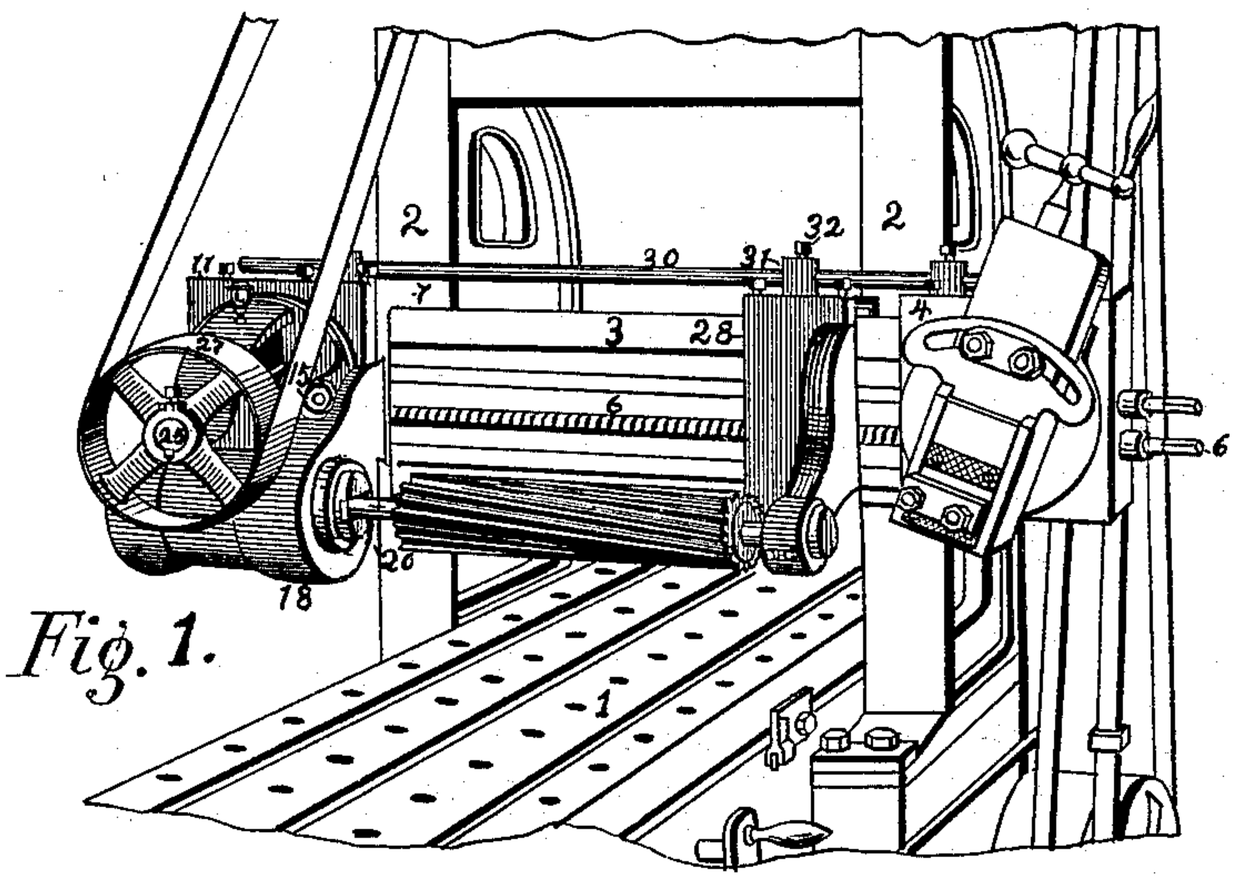

Fig. 1.

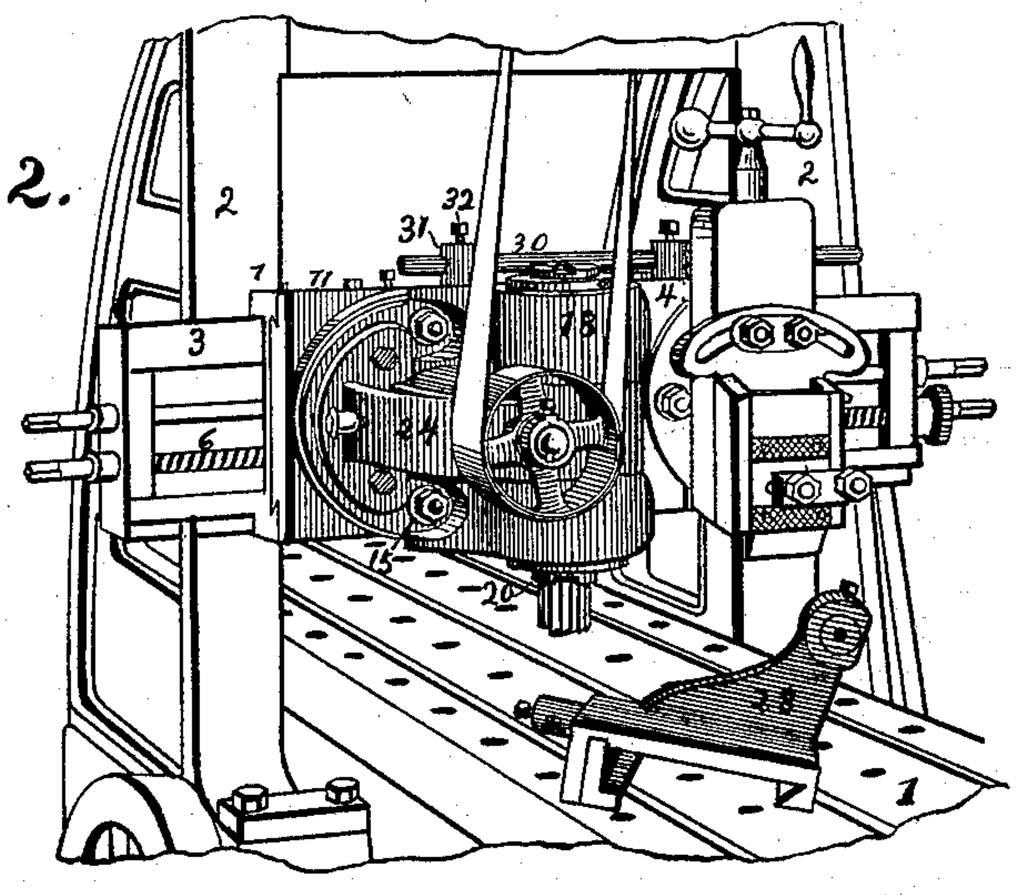

Fig. 2.

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(No Model.) 4 Sheets—Sheet 2.

F. O. FARWELL.

MILLING MACHINE.

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Fig. 3.

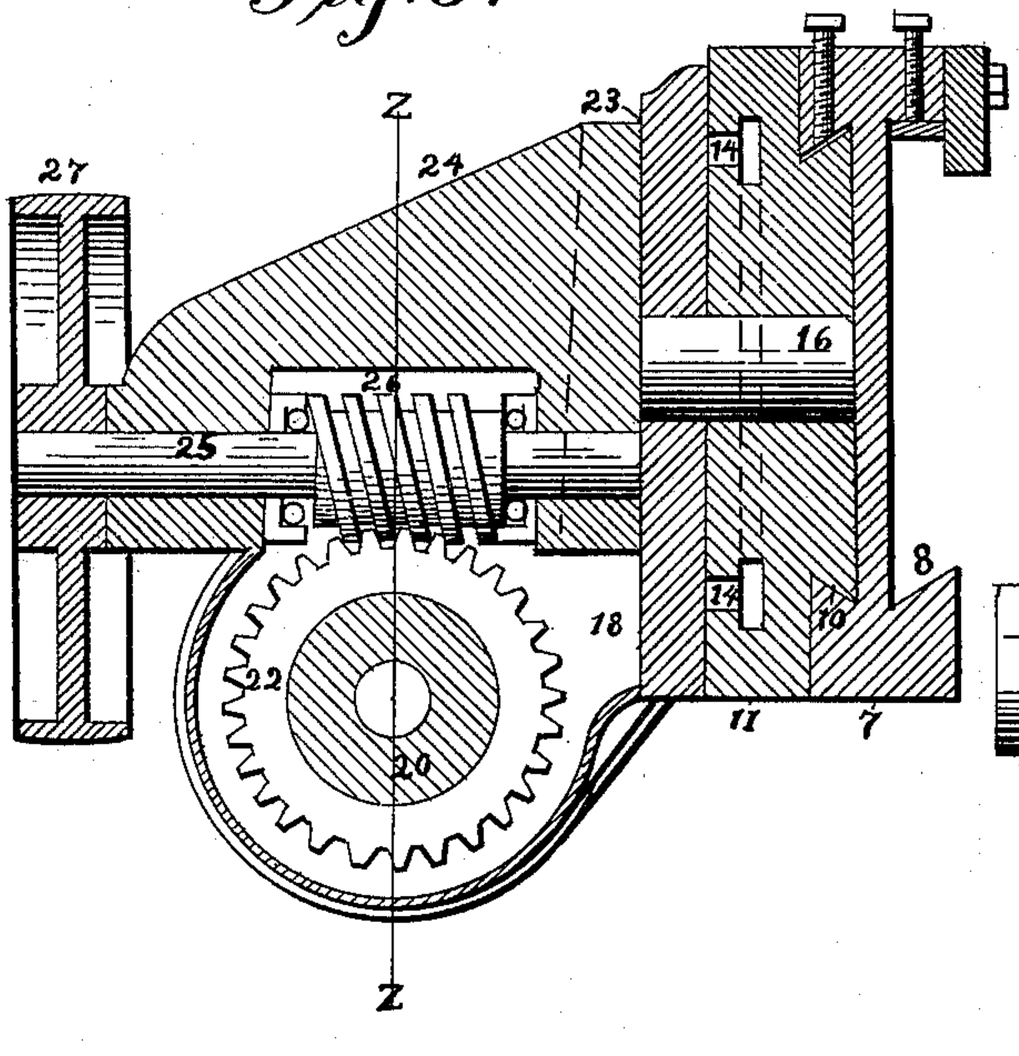


Fig. 4.

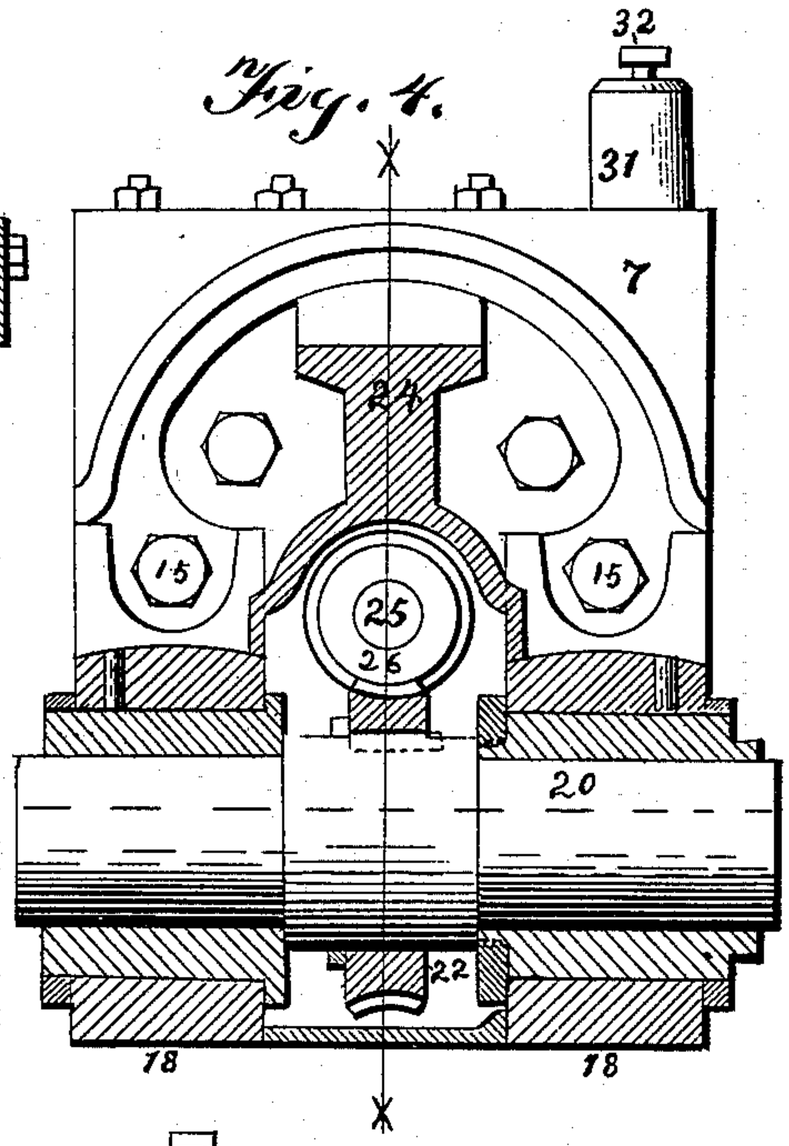
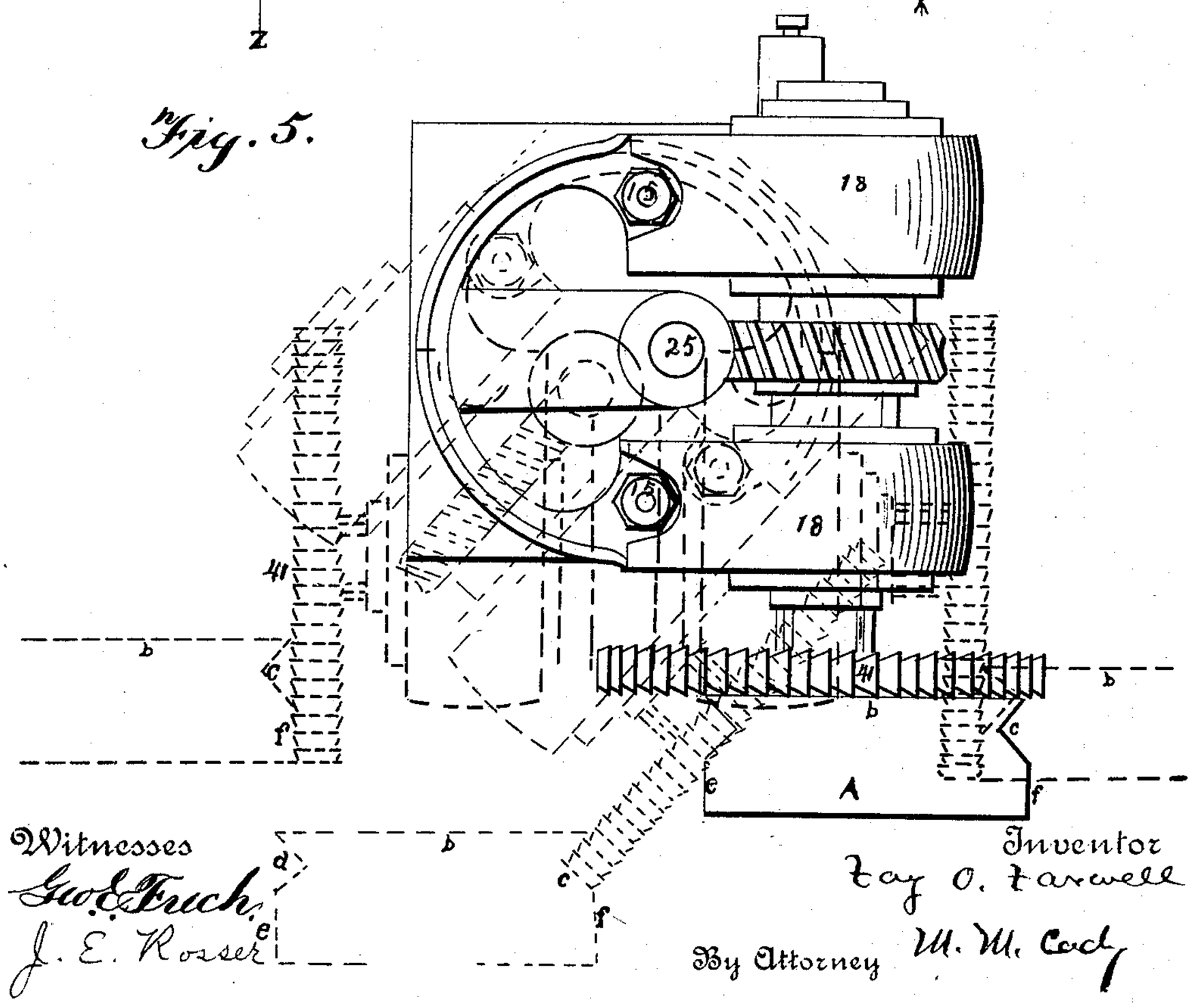


Fig. 5.



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(No Model.) 4 Sheets—Sheet 3.

F. O. FARWELL.

MILLING MACHINE.

No. 596,491. Patented Jan. 4, 1898.

Fig. 6.

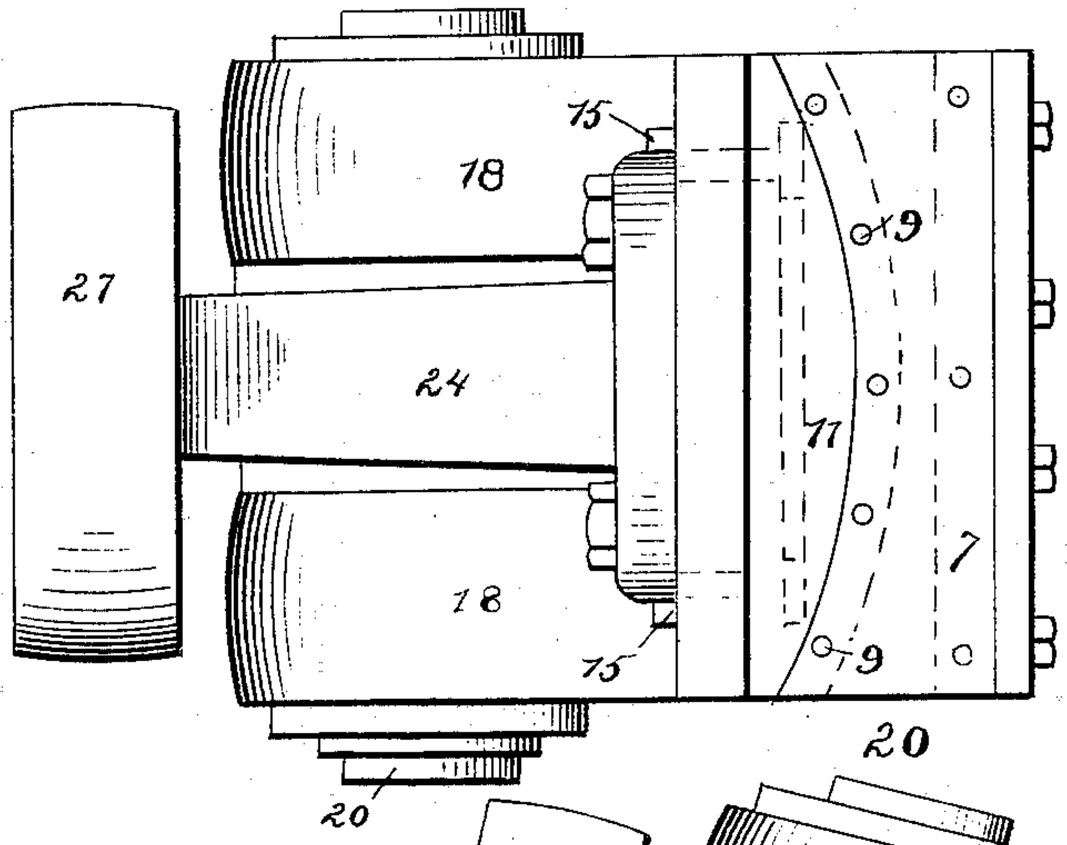

Fig. 8.

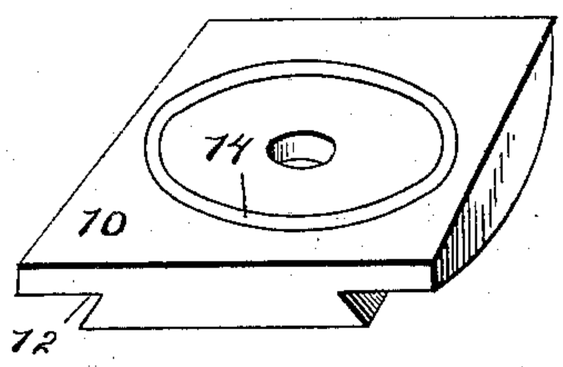

Fig. 7.

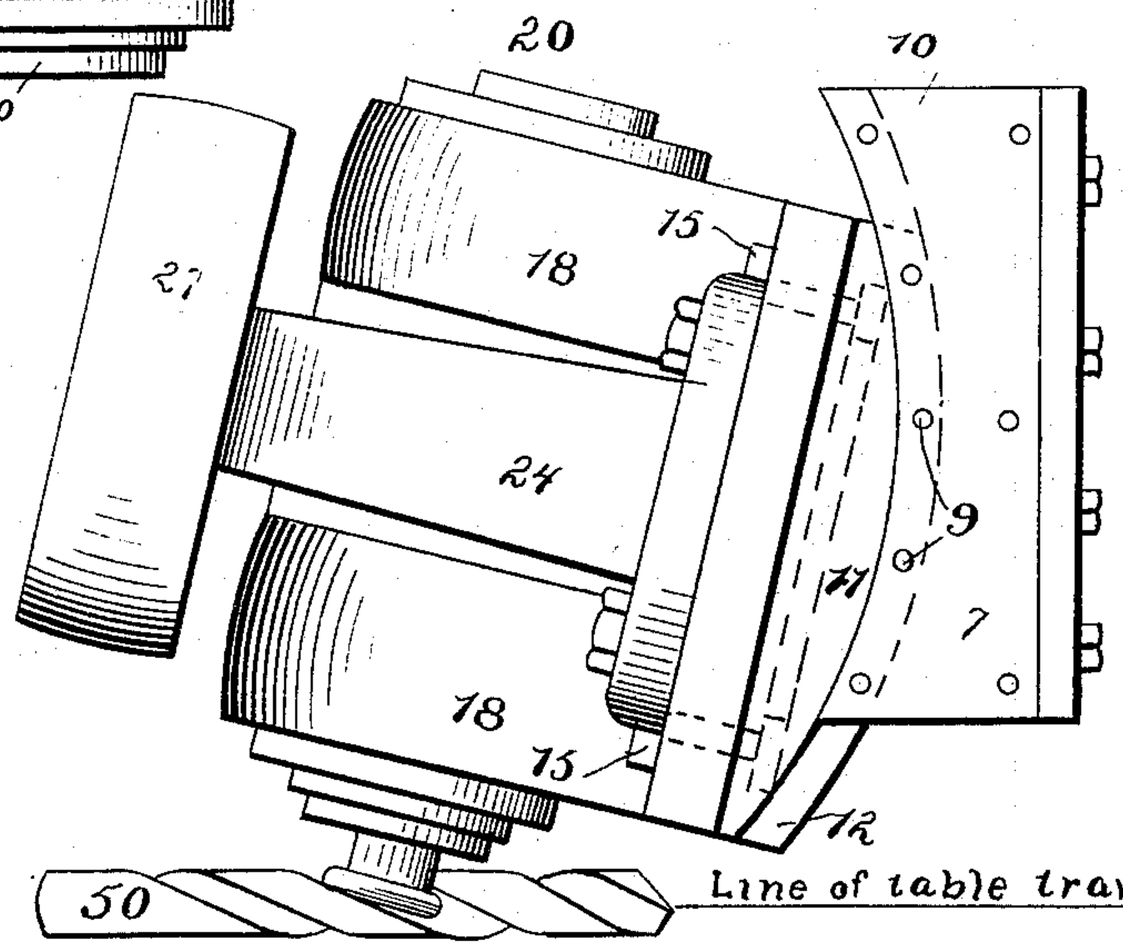

Fig. 9.

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MILLING MACHINE.

No. 596,491. Patented Jan. 4, 1898.

Fig. 10.

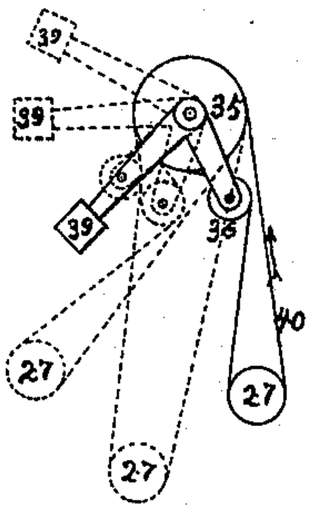


Fig. 11.

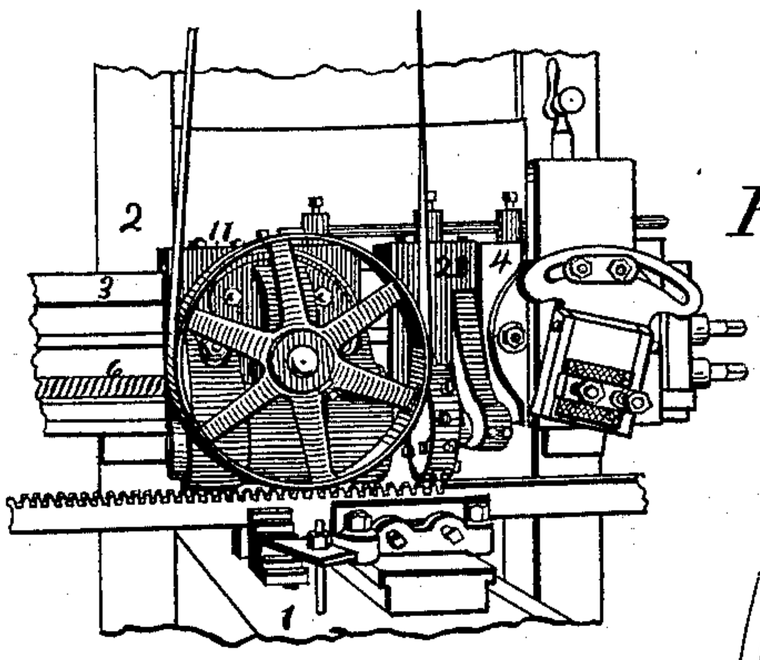


Fig. 12.

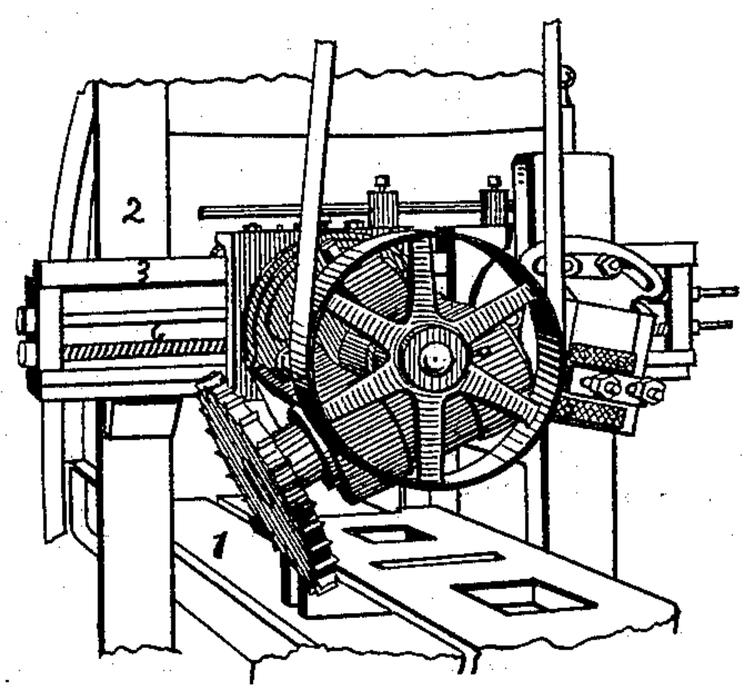
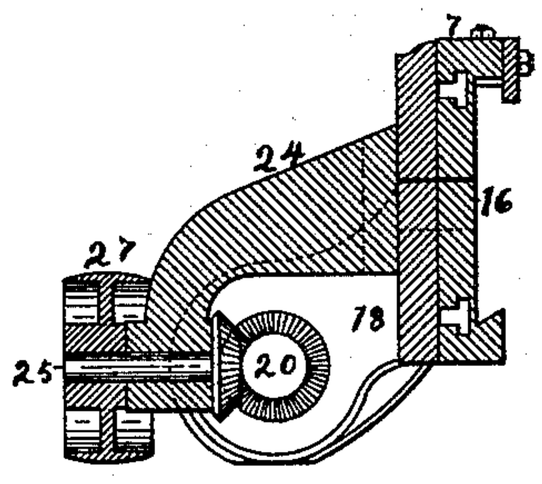


Fig. 13.



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ATTORNEY.

UNITED STATES PATENT OFFICE.

FAY O. FARWELL, OF DUBUQUE, IOWA, ASSIGNOR OF ONE-HALF TO THE ADAMS COMPANY, OF SAME PLACE.

MILLING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 596,491, dated January 4, 1898.

Application filed February 25, 1896. Serial No. 580,653. (No model.)

To all whom it may concern:

Be it known that I, FAY O. FARWELL, a citizen of the United States, residing at Dubuque, in the county of Dubuque and State of Iowa, have invented certain new and useful Improvements in Milling-Machines; and I do hereby 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.

My invention relates to milling-machines, with special reference to those having a horizontally-moving table upon which the work to be milled is chucked, and has for one of its leading objects to so set the milling-head and provide it with such means that it will have a universal movement in both a horizontal and vertical plane, whereby the work chucked upon the table and having a bevel or other angular surface may be operated upon at the different angles without rechucking the work upon the table or without providing other and special forms of cutters with angles especially adapted to attack the different angles of the work upon the table.

A further purpose and thought is to adapt a milling-machine for cutting spiral grooves in drills, reamers, and that class of tools without swiveling or changing the position of the horizontally-moving table upon its base and have the work travel in the line of the cutters by arranging the cutters in the milling-head, whereby they will attack the work upon the horizontally-moving table at any angle.

It is a further thought to attach a milling-head to a cross-rail on an ordinary planer and either mill or plane the various surfaces of the work without rechucking the same on the table or without transferring the work from one machine to another.

Another object is to provide a milling-machine with means whereby it will be adapted to do a larger variety of work and work of much larger dimensions than that usually operated upon by a milling-machine, and this without any change in the position of the travel of the horizontally-moving table or the use of special cutters.

Another object is to provide the milling-head with a spindle adapted to receive and operate a cutter at either end of the same and adapt it to operate upon a larger variety of work.

A still further object is to operate the milling-head with motor-power which shall readily and effectually operate the cutters at whatever angle the milling-head may be made to assume in any vertical or horizontal plane.

These, with numerous other objects of less moment, will be fully set out and described in detail in the following specification, with special reference being had to the accompanying drawings, in which—

Figure 1 shows the machine in perspective, the milling-head in a horizontal position and the outboard center or arbor-support attached to the rail and a milling-cutter in right end of spindle and supported by the outboard center. Fig. 2 is a perspective of the machine, showing milling-head in a vertical position, the outboard center removed and lying on the table, and an end mill in the left and the lower end of spindle. Fig. 3 is a sectional view on the line X X of Fig. 4, showing the arrangement of the driving-shaft and worm-gear mechanism, together with the ball-bearings, &c. Fig. 4 is a section on line Z Z of Fig. 3, showing construction of the spindle-bearings. Fig. 5 is a front view of the milling-head in three positions. The full lines show the milling-head in vertical position. The heavy dotted lines show the head in a horizontal position. The light dotted lines show the head in angular position. Fig. 6 is a top view of the milling-head, showing the spindle at a right angle to the travel of the table. Fig. 7 is a top view of the milling-head, showing the spindle set at an angle other than a right angle to the travel of the table. Fig. 8 is a perspective of the intermediate saddle in which the milling-head is swiveled. Fig. 9 is a perspective of the main saddle which engages with the rail and to which the head is swiveled through the intermediate saddle. Fig. 10 shows the countershaft pulley belted to the worm-shaft pulley and a mode of taking up the slack of the belt. Fig. 11 shows the machine while milling a rack-bar of great length. Fig. 12 shows the machine in operation upon a beveled side of a large slab of iron. Fig. 13 is a section of

the milling-head, showing a modified form of the driving-gear.

Like letters of reference denote corresponding parts in all of the drawings.

In the drawings, 1 represents the bed of an ordinary planer, 2 the housing, and 3 the cross-rail, which is adjustably secured to the housing 2 and adapted to be raised and lowered thereon. To the rail 3 is gibbed a planer-saddle 4, which is operated transversely on the rail 3 by the screw 6.

The foregoing description shows the construction of ordinary planer to which my invention may be attached. This part of the machine may be built expressly to receive my milling-head, and in such case the planer-saddle 4 would be entirely omitted, or my milling-head may be attached to the rail of any ordinary planer, as shown, and by means of devices hereinafter described convert the machine into a combined planer and milling-machine.

The precise manner of constructing or operating the table-feed or raising and lowering the rail 3 upon the housing or of moving the milling-head across the table upon the rail is unimportant and may be made in various ways. The milling-head is movably secured upon the cross-rail 3, and is constructed and set in the following manner: To the cross-rail 3 is hung a saddle 7 (shown in Fig. 9) by the dovetail 8, which engages with the upper and lower edges of the cross-rail 3. The front side of the saddle 7 is formed into a concave dovetail 10. An intermediate saddle 11 (shown in Fig. 8) is formed into a convex dovetail tenon 12 to engage with the dovetail 10 of the saddle 7 and is secured by set-screws 9. Into the face of the saddle 11 is turned a T-shaped recess 14, (shown in section in Fig. 3,) into which the head of bolts 15, which secure the spindle-bracket, presently to be described, to the intermediate saddle 11, are secured. In the center of the saddle 11 is a hole, in which the stud 16 (shown in Fig. 3) is inserted for the purpose of swiveling the spindle-bracket to the saddle.

The spindle-bracket is cast with brackets 18, which support the boxes in which the spindle 20 revolves. Near the center of the spindle is set a worm-wheel 22 for the purpose of communicating power to the spindle. Secured to the face of the spindle-bracket at 23 is a worm-shaft hanger 24, which forms a bearing for the worm-shaft 25. The worm 26 is set on the shaft 25 and adapted to engage with the worm-wheel 22. At the outer end of the shaft 25 is a pulley 27, which is belted to the source of power, and power is communicated to the spindle 20 by the pulley 35, belted with the pulley 27, through the shaft 25, worm 26, and worm-wheel 22. In the construction of my invention a bevel-gear may be substituted for the worm-gear, as shown in Fig. 13, if it is desired to drive the spindle with greater rapidity, but with less power. When my invention is attached to an ordinary planer, the saddle 7 of the milling-head and an outboard center 28 are both connected to the planer-saddle 4 by means of a rod 30, passing through binder-posts 31 and secured by set-screws 32. By this means a transverse movement across the rail 3 is imparted to the milling-head and outboard center 28 by means of the saddle 4 engaging the screw 6. It will be noticed that if the saddle 4 were omitted the milling-head saddle 7 would be directly connected to the screw 6.

A convenient mode of operating the pulley 27 is shown in Fig. 10 and preferably consists of a driving-pulley 35 and a tightener-pulley 36. The tightener-pulley 36 is journaled to one arm of a bell-crank 37, and a weight 38 is attached to the other end of the bell-crank. It will be observed by this mode of construction that the driving-pulley 35 and the driving-pulley 27 are at all times in alinement, and by means of the weighted tightener-pulley 36 the driving-belt 40 is kept taut at whatever position the milling-head may at any time assume. It will further be observed that if the pulley-shaft 25 were in any position other than at a right angle to the spindle or nearly a right angle to the travel of the milling-head along the rail or the travel of a rail upon the housing the belt could not be driven from the pulley 35 to the pulley 27. The pulley 27 is made sufficiently wide of face to accommodate the travel of the belt when the head is set at an angle, as shown in Fig. 7.

The foregoing description applies when this machine is used as a "universal" milling-machine—that is, when the spindle may be set at angle with the travel of the table, as shown in Fig. 7, where it is shown as cutting spiral grooves; but when it is desired to dispense with this feature and make it a "plain" milling-machine I dispense with the intermediate saddle 11 (shown in Fig. 8) and attach the spindle-bracket directly to the face of the saddle 7 (shown in Fig. 9) by making the face of the saddle 7 parallel with the back of the same instead of being concaved, as shown, and the T-shaped recess 14, as shown in Figs. 3 and 8, which is turned in the face of the saddle 11, would be turned in the face of the saddle 7.

The general operation of my device would be as follows: The work to be operated upon, as A in Fig. 5, would be clamped upon the table 1. To finish the horizontal surface *b*, a face milling-cutter 41 would be secured to the left end of the spindle 20. The bolts 15 would now be loosened and the spindle swiveled to a horizontal position, as shown in Figs. 2 and 5 in full lines, and the bolts tightened, securely locking the head in that position. The rod 30 is now passed through the binder-posts 31 and tightened by the set-screws 32, which connect the milling-head to the planer-saddle. By means of the screw 6 the milling-head is brought to the proper position over the work A. The rail 3 is now adjusted vertically upon the housing 2, bringing the cutter to the proper height. The table would

then be given a slow longitudinal motion beneath the cutter, which in revolving would finish the surface *b* of the piece of work A. Now to finish the angular surface *c* the bolts 15 15 will be again loosened and the milling-head swiveled to the proper angle and locked, as shown in Fig. 5 in light dotted lines. After the surface *c* has been finished the spindle will be swiveled and locked in a horizontal position, as shown in Fig. 5 in heavy dotted lines, when the surface *f* would be finished. If the block of work A were not of great width, all of the surfaces *b*, *c*, *d*, *e*, and *f* could be finished with the same cutter secured to either right or left end of the spindle. If, however, the piece of work A were of considerable width, it would be necessary to change the cutter from the left end of the spindle, in which position it would finish the surface *b*, *f*, and *d*, to the right end of the spindle, in which position it would finish the surface *c* and *e*. When the milling-head is used as an attachment to a "planer," the planer-saddle 4 prevents the head from traveling to the extreme right end of the rail 3. It is therefore important that the left end of the spindle be arranged to receive cutters; otherwise when the spindle is set vertically the cutter could not be brought to act upon the work attached to the extreme right edge of the table. It will be observed also that when the nature of the work would require the use of a mill in a horizontal position on part of the work and the use of a mill in a vertical position on other parts a horizontal mill could be attached to the right end of the spindle and a vertical mill to the left end of the spindle, and it would be merely necessary to loosen the bolts 15 15 and swivel the head from a horizontal to a vertical position in operating upon different parts of the work, it being unnecessary to remove the horizontal mill and attach the vertical mill, as would be the case if but one end of the spindle was provided with means in which to secure mills.

When an arbor holding a cutter of considerable length is used, as shown in Fig. 1, the outboard center 28 is secured to the rail 3 to support the outer end of the arbor. The rod 30 passes through the binder-posts 31, and by tightening the set-screws 32 the milling-head and outboard center 28 would be connected to the saddle 4, and by means of the screw 6 transverse motion would be given to the milling-cutter.

When it is desired to cut spiral grooves, it is necessary that the work should travel at an angle to the line of the spindle, as shown in Fig. 7. In the ordinary planer there is no provision for swiveling the table to make it travel at any other than a right angle to the rail. It is therefore necessary that the spindle should be set at an angle to the travel of the table. By loosening the set-screws 9 upon the top of the saddle 7 the convex surface of the saddle 11 will be allowed to slide in the concave dovetail 10 of the saddle 7, which will enable the spindle to be swiveled on a horizontal plane and secured at any desired angle, as shown in Fig. 7.

Fig. 11 shows the machine operating upon a rack-bar of great length. It will be observed that the cutter is operating upon the center of a bar of considerable length, which would be impossible to reach on an ordinary milling-machine, because of the frame that supports the spindle and the manner of driving the same. By my mode of construction it will be observed that the milling-head may pass over the work and enable the cutter to reach any point of the bar of any length.

Fig. 12 shows the machine in operation upon the bevel side of a slab of iron. Here it will be observed that the cutter is secured to the left end of the spindle. If there was no provision made for securing the cutter in the left end of the spindle, this edge of the slab could not be reached by the cutter, and it would be necessary to rechuck the work.

It will be seen that to enable the cutters to reach the work which passes beneath the rail on the table, when the spindle is in a horizontal position, it is necessary that the spindle be set near to or below the line of the lower edge of the saddle 7 and lower edge of the cross-rail, as shown.

Having now described my invention, what I claim, and desire to secure by Letters Patent, is—

1. In a milling-machine, a supporting cross-rail, a saddle which is moved back and forth thereon, and an intermediate saddle which moves upon a horizontal curved line, combined with a bracket which is adapted to be revolved upon the saddle, and a spindle journaled in the bracket, substantially as shown.

2. In a milling-machine, a milling-head carrying a spindle, a cross-rail along which the milling-head is adapted to be moved, and a saddle carrying the milling-head, and which is adjustable back and forth in relation to the cross-rail upon a curved line, substantially as described.

3. In a milling-machine, a milling-head carrying a spindle, means for placing the head in a universal position, a cross-rail along which said head is adapted to be moved horizontally on a curved line, and a table for holding the work to be milled adapted to travel beneath the rail and at right angles thereto, for the purposes shown.

4. In a milling-machine, a cross-rail set above the table, a primary saddle adapted to be moved longitudinally along said rail, an intermediate saddle attached to the primary saddle and adapted to be adjusted in a curved horizontal plane and a milling-head carrying a spindle swiveled to said intermediate saddle, whereby said spindle may be set in universal position.

5. In a milling-machine, a cross-rail secured to the housing of the machine, a saddle secured to said rail and adapted to be moved thereon, an intermediate saddle, moving upon

a horizontal curved plane, and a bracket swiveled to said intermediate saddle and carrying a double-ended spindle, each end provided with means for holding a milling-cutter, for the purposes shown.

6. In a milling-machine, a cross-rail secured to the housing, a primary saddle adapted to be moved along said rail and having a concave dovetail on its outer side, and an intermediate saddle having a convex dovetail on one side to engage the concave dovetail in the primary saddle, whereby the sliding of the intermediate saddle on the primary saddle will swing them in and out of a parallel with each other, for the purposes shown.

7. In a milling-machine, a housing, a longitudinally-moving table within the housing, a cross-rail secured to said housing above the table, a primary saddle adapted to be moved along said rail, an intermediate saddle attached to said primary saddle and adapted to be adjusted horizontally in a curved line thereon, a bracket swiveled to said intermediate saddle and carrying a spindle and driving-gear secured in said bracket, all combined to operate, for the purposes shown.

8. In a milling-machine, an upright housing, a cross-rail attached to said housing, means for raising and lowering said cross-rail in a vertical plane on the housing and securing it thereto, a saddle adapted to be moved along said rail, an intermediate saddle that is horizontally adjustable on a curved line on the main saddle, and a milling-head swiveled to said intermediate saddle, for the purposes shown.

9. In a milling-machine, an upright housing, a longitudinally-moving table in said housing, a cross-rail secured above the table, a saddle set upon said rail and adapted to be moved longitudinally along the same, an intermediate saddle which moves on a horizontal curved line, a bracket swiveled to said saddle, a milling-head carrying a spindle, and means for driving said spindle secured within said bracket, all combined to operate for the purposes shown.

10. In a milling-machine, a cross-rail secured to the housing, a saddle adapted to be moved longitudinally along said rail, an intermediate saddle that is adjustable horizontally in a curved line upon the main saddle, a bracket swiveled to said saddle and a driving-shaft carrying a pulley attached to said bracket at right angles to the face of said saddle, whereby the pulley on the driving-shaft remains in line with the counter-shaft whatever position the bracket may assume on the saddle or the saddle upon the rail.

11. In a milling-machine of the character described, the combination of a cross-rail, a longitudinally-moving table, a planer-head saddle adapted to move across said rail, a second intermediate saddle that is horizontally adjustable in a curved line upon the main saddle, a milling-head swiveled upon said second saddle, an arbor-support adapted to move across the rail, a binder-post secured to the saddle of the planer-head, to the saddle of the milling-head and to the arbor-support, and a rod engaging these three binder-posts, whereby the moving of the planer-head along the rail transmits a movement to the milling-head, and arbor-support, substantially as described and shown.

12. In a milling-machine, a milling-head carrying a spindle, a cross-rail along which the milling-head is adapted to be moved, and an intermediate saddle which has a horizontal curved motion, combined with means for swiveling the head, and with it the spindle in a vertical plane, substantially as specified.

13. A milling-machine, consisting of housing 2, cross-rail 3, table 1, saddle 7, a bracket swiveled upon said saddle, worm-gear secured in said bracket, driving-shaft 25, pulley 27, and spindle 20 adapted to receive a cutter at each end thereof, all combined to operate as and for the purpose shown.

14. In a milling-machine, a cross-rail, a saddle adapted to move upon said cross-rail, a milling-head swiveled to said saddle, a rotating milling-spindle set at one side of the head, and when adjusted to a horizontal position it will be at or below the lower edge of the cross-rail, and means set in the head for rotating said spindle, as and for the purposes shown.

15. In a milling-machine, a cross-rail, a saddle, means for moving said saddle along said rail, a milling-head swiveled to said saddle, and carrying a rotating spindle, adapted to receive and operate a rotating milling-cutter in either end, and a driving mechanism, consisting of a pulley 27, shaft 25, gear connecting the shaft 25 with the spindle, all combined to operate as and for the purposes shown.

16. The combination of a cross-rail, a saddle adapted to be moved along the cross-rail, a milling-head swiveled to the saddle, a spindle set in one side of the head and a driving mechanism consisting of a shaft 25, a gear connecting the shaft with the spindle and means set in the milling-head for rotating the shaft and with it the spindle, all combined to operate as and for the purposes shown.

17. The combination of a cross-rail, a saddle, a bracket swiveled to said saddle, a rotating spindle adapted to receive a rotating milling-cutter at either end thereof secured in the bracket and when adjusted to a horizontal plane will be at or below the lower edge of the saddle, and a driving mechanism consisting of a pulley 27, a driving-shaft 25, set at right angles to the face of the saddle, and a gear connecting the shaft with the spindle, all combined to operate as and for the purposes shown.

In testimony whereof I affix my signature in the presence of two witnesses.

FAY O. FARWELL.

Witnesses:
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J. E. ROSSER.