(No Model.) 4 Sheets—Sheet 1.

L. D. BURLINGAME.

MILLING MACHINE.

No. 597,390 Patented Jan. 18, 1898.

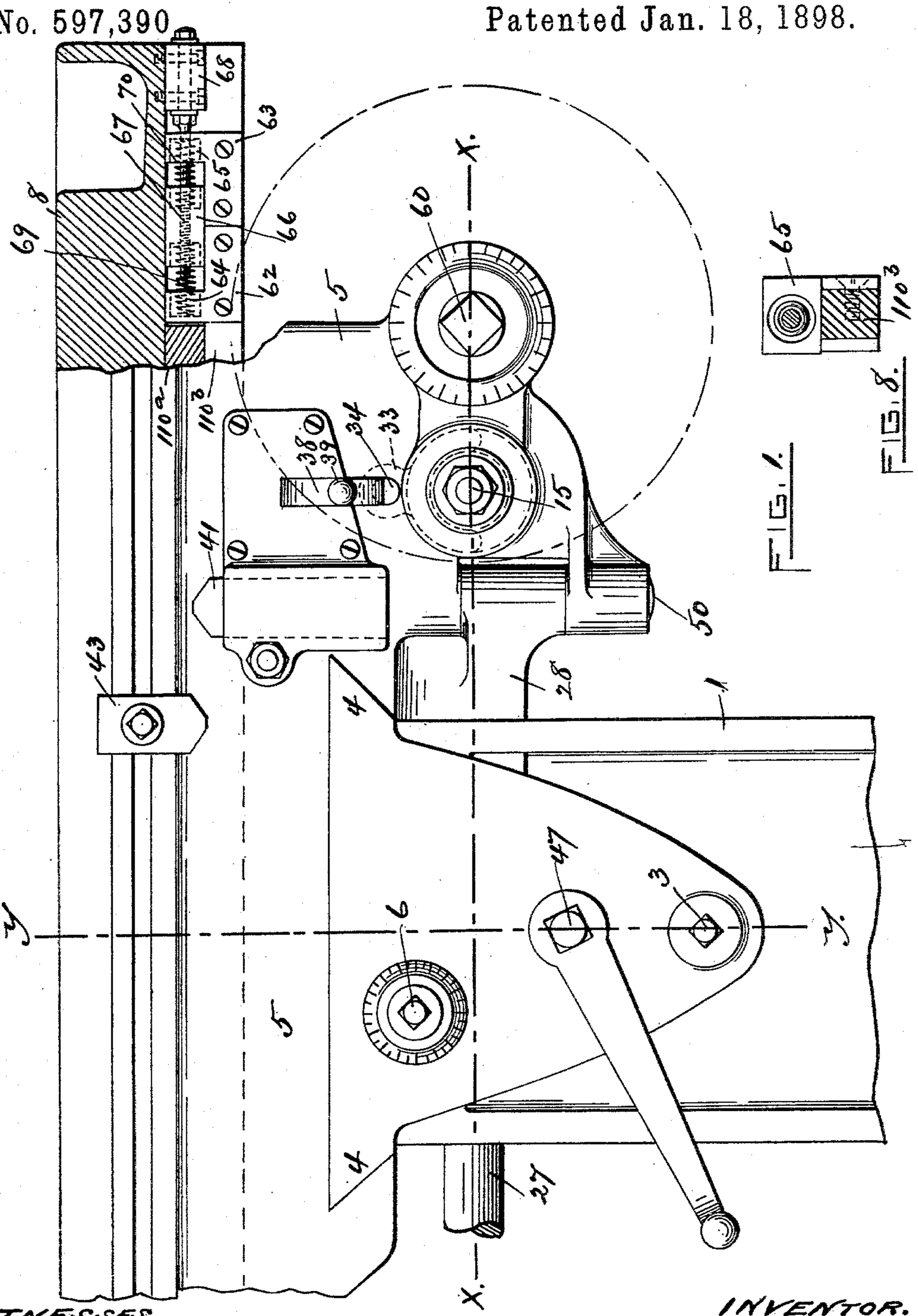

FIG. 1.

FIG. 8.

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By Wilmarth & Thurston

Att'ys

(No Model.)

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L. D. BURLINGAME.

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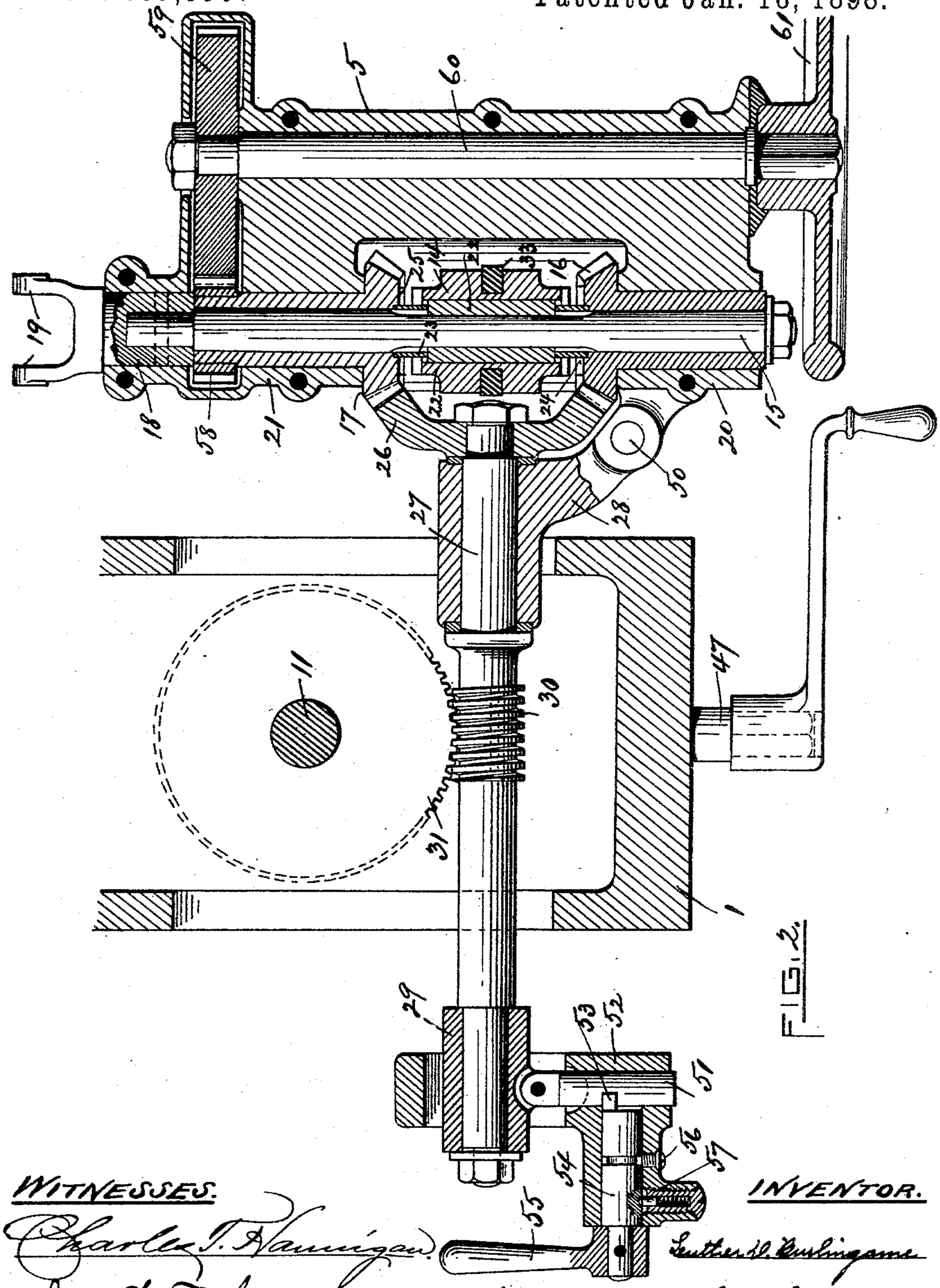

FIG. 2.

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(No Model.)

4 Sheets—Sheet 3.

L. D. BURLINGAME.

MILLING MACHINE.

No. 597,390. Patented Jan. 18, 1898.

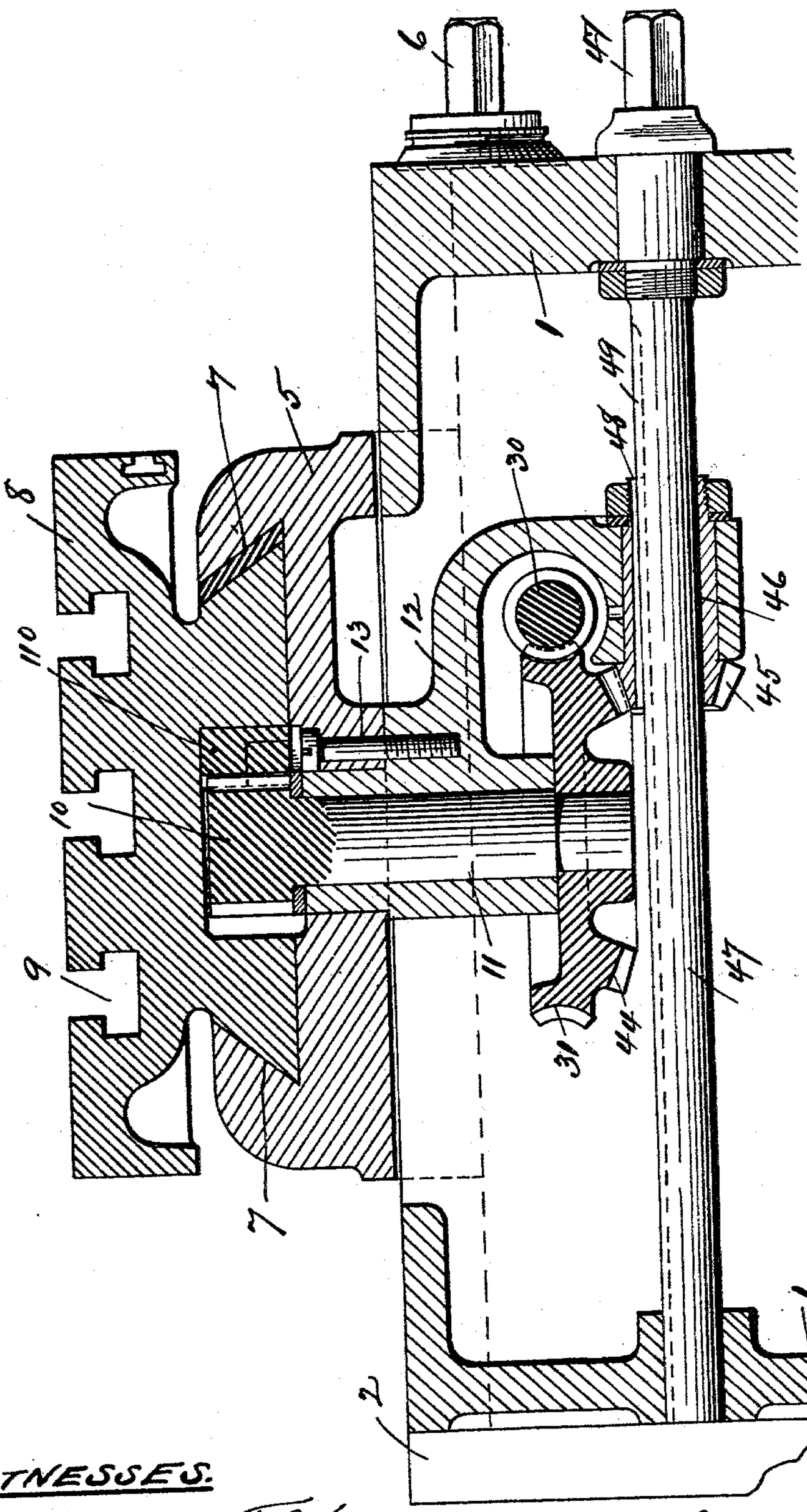

FIG. 3.

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(No Model.) 4 Sheets—Sheet 4.

L. D. BURLINGAME.

MILLING MACHINE.

No. 597,390. Patented Jan. 18, 1898.

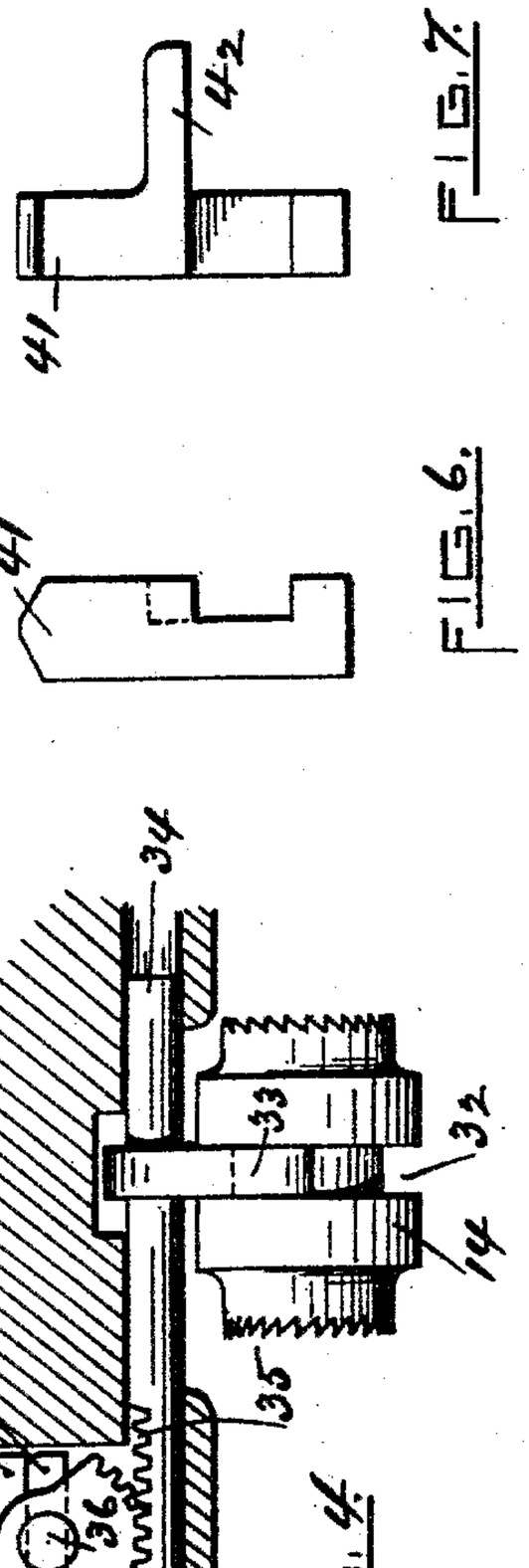

FIG. 6. FIG. 7.

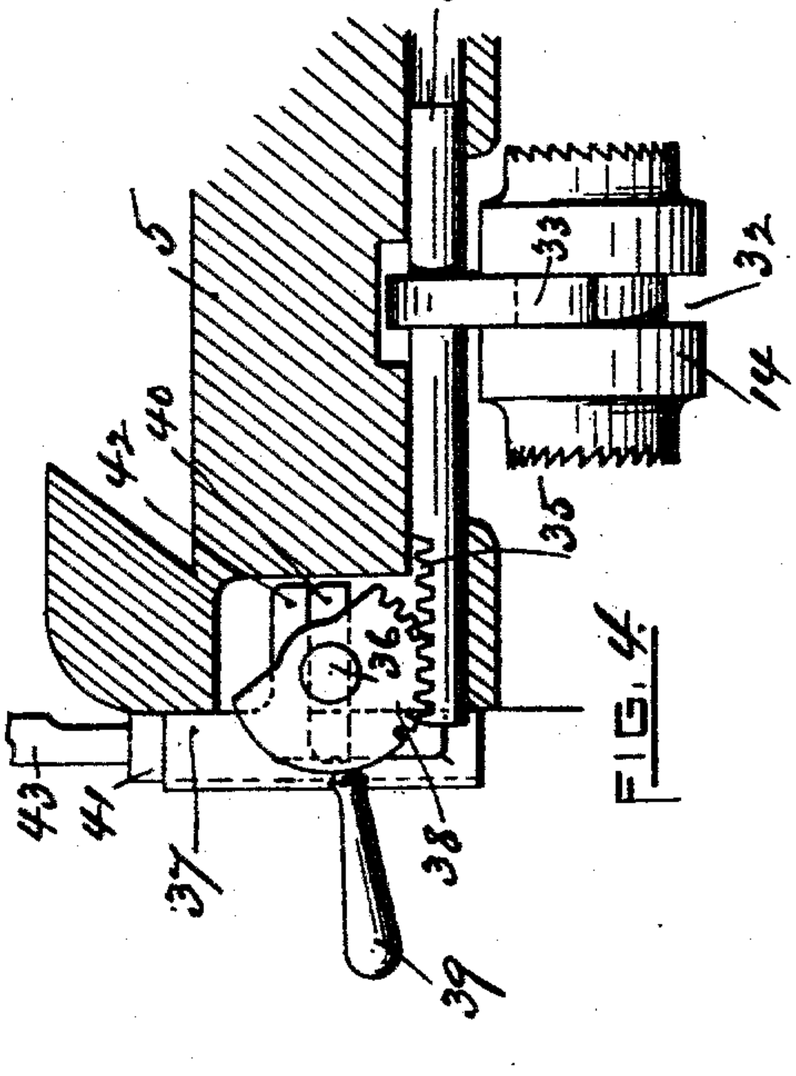

FIG. 4.

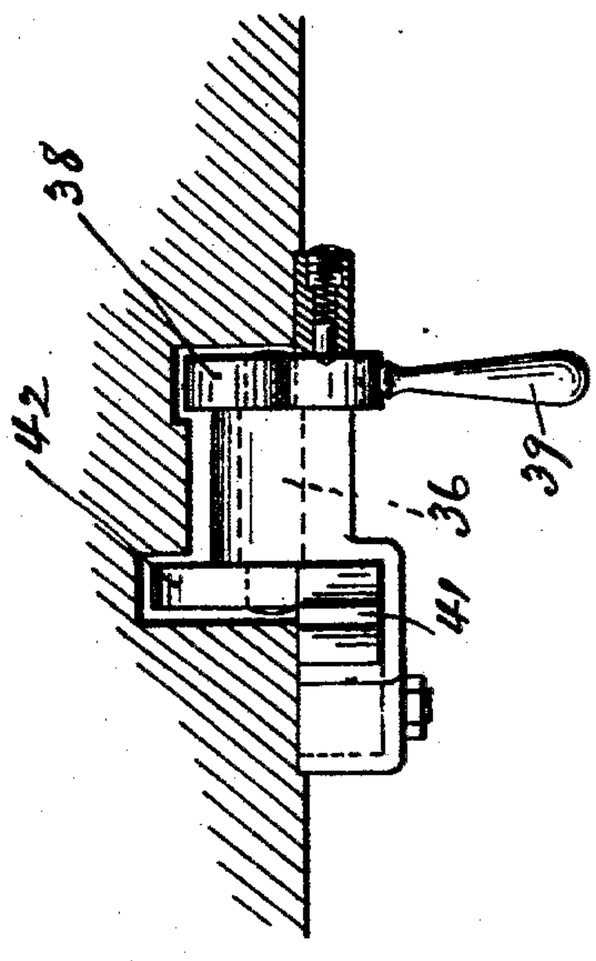

FIG. 5.

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UNITED STATES PATENT OFFICE.

LUTHER D. BURLINGAME, OF PAWTUXET, RHODE ISLAND, ASSIGNOR TO THE BROWN & SHARPE MANUFACTURING COMPANY, OF PROVIDENCE, RHODE ISLAND.

MILLING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 597,390, dated January 18, 1898.

Application filed January 25, 1897. Serial No. 620,585. (No model.)

To all whom it may concern:

Be it known that I, LUTHER D. BURLINGAME, of Pawtuxet, in the county of Kent and State of Rhode Island, have invented certain new and useful Improvements in Milling-Machines; and I do hereby declare the following specification, taken in connection with the accompanying drawings, forming part of the same, to be a full, clear, and exact description thereof.

The present invention relates to that class of machines in which a rotary cutter or milling-tool is employed to act upon the work, which is carried past the tool by means of a movable or adjustable table, and the main features of the invention relate more especially to that class of machines in which the table is moved by means of a rack and pinion and commonly called "rack-feed" machines.

In rack-feed machines as heretofore constructed the mechanism for automatically feeding the table has been so constructed and arranged that when said mechanism is thrown out of operation automatically said table is free to be moved in either direction, with the result that the table is liable to be moved by the action of the cutter on the work or to be accidentally displaced and thus injure both the cutter and the work. One of the features of the present invention accordingly consists in means for holding or locking the table of a rack-feed machine in position when the means for feeding the table is automatically thrown out of operation.

It is frequently desirable in milling-machines to manually operate the saddle and the table simultaneously, but in rack-feed machines as heretofore constructed the hand-feed for the saddle and the hand-feed for the table have been so arranged that this could not be accomplished; and another feature of the invention consists in providing a rack-feed machine with a saddle-feed and a table-feed which are so arranged that they may be manually operated simultaneously.

In machines in which the table is fed by means of a screw it has been possible under some conditions to manually operate the saddle and the table simultaneously by reason of the fact that the crank for manually operating the table is located at the end of the table. With certain adjustments of the table, however, such operation is inconvenient or, in the case of large machines, impossible by reason of the distance between the means for operating the saddle and the table-operating means; and another feature of the present invention accordingly consists in providing a milling-machine with a manually-operated saddle-feed and a manually-operated table-feed adjacent to said saddle-feed and so arranged that it may be operated simultaneously therewith, whereby the table and saddle may be conveniently operated simultaneously without regard to the position of the table or the size of the machine, and it is immaterial, so far as this feature of the invention is concerned, whether the machine be a rack-feed machine or some other form of table-operating means be used.

A further feature of invention relates to means for readily and conveniently reversing the automatic feed for the table, so that the machine may be operated to cut in either direction.

A further feature of invention relates to an improved means for taking up the backlash between two intermeshing toothed members.

The invention further consists in certain other features and combinations hereinafter described and claimed.

Referring to the drawings, Figure 1 is a front elevation showing so much of a milling-machine embodying one form of the present improvements as is necessary to illustrate the same. Fig. 2 is a sectional view on line *x x*, Fig. 1. Fig. 3 is a sectional view on line *y y*, Fig. 1. Figs. 4 to 7, inclusive, are details showing the means for operating the automatic feed-clutch. Fig. 8 is a detail of the device for taking up backlash.

The cutter-bearing spindle, the feed-cones, and the various parts of the machine not shown may be of any well-known construction, and the knee 1 may be suitably guided on guideways formed on the frame of the machine and engaged by the ways 2 in the usual manner, the knee being adjusted vertically by any well-known means commonly used and actuated by means of a rod 3, projecting

from the front of the knee and adapted to be operated by a removable handle or crank.

As shown in the drawings, the knee is provided with ways 4, on which the saddle 5 is mounted, said saddle being moved or adjusted by means of a rod 6, projecting from the front of the knee and adapted to be turned by a removable handle or crank, the rod acting through any well-known mechanism to move the saddle. The saddle 5 is provided with ways 7, and the table 8 is mounted in said ways and is provided with undercut grooves 9 for the purpose of securing thereto the work or the work-supporting devices. A rack 110 is secured to the table and is engaged by a pinion 10, formed upon a stud 11, mounted in a bracket 12, depending from the saddle and secured thereto by a bolt 13.

Any suitable means may be used for operating the pinion 10 to feed the table, and any suitable means for locking the table in position when the said operating means is automatically thrown out may be employed, and in the drawings is shown a form of such means which it is preferred to use. In the form shown the pinion 10 is driven from a clutch 14, keyed to revolve with the shaft 15 and adapted to be shifted into engagement with one or the other of two beveled gears 16 17, the table being fed in one direction or the other, depending upon which of the gears the driving-clutch is in engagement with. A bushing 18 is secured to the shaft 15 at its rear end and is mounted in a bearing formed on the saddle. The bushing 18 is provided with lugs 19, and said bushing may be connected to the feed-cone or other operating means in any well-known manner.

The beveled gears 16 and 17 are provided with projecting hubs which are mounted to revolve in bearings 20 21, formed in the saddle 5, the shaft 15 passing through the hubs of said gears and being supported thereby. The shaft 15 is provided with two grooves between the gears 16 and 17, in which are two keys 22, which pass through slots formed in a sleeve 23, interposed between the gears 16 and 17, and engage grooves formed in the clutch 7, said clutch being thus revolved continuously with the shaft 15, while being capable of a sliding motion thereon. The gears 16 and 17 are provided with clutch-faces 24 25, adapted to engage the clutch-faces on the clutch 14. The gears 16 and 17 are in mesh with a beveled gear 26, secured to a shaft 27, mounted in bearings 28 29, carried by the saddle 5. The shaft 27 carries a worm 30, which engages a worm-wheel 31, secured to stud 11, and said worm and worm-wheel serve in this instance to lock the table in position when the clutch 14 is shifted to throw the automatic feed out of operation. While it is preferred to so connect the pinion 10 with its driving means that said connections will form the means for locking the table when the driving means is rendered inoperative, it will be understood that the invention is not limited to this form of locking means, but that any form of such means may be employed and that said means may be independent of the said connections without departing from the present invention.

The driving-clutch 14 may be shifted to throw the automatic feed out of operation or to change the direction of the feed by any suitable means and in the form shown is shifted by the following mechanism: The clutch 14 is provided with an annular groove 32, which is engaged by a yoke 33, secured to a rod or bar 34, sliding in guides formed in the saddle 5 and provided at its forward end with rack-teeth 35. A stud 36 is mounted in a plate 37, secured to the front of the saddle, and has secured thereto a segmental gear 38, which engages the rack-teeth on the rod 34. A handle 39 projects from the gear 38, and by operating said handle the clutch 14 may be shifted as desired. The means for shifting said clutch automatically, so that the automatic feed is thrown out of operation, is as follows: A plate 40 is secured to the stud 36 and occupies a horizontal position when the clutch 14 is out of engagement with both the gears 16 and 17, in which position of the clutch the means for operating the table is out of operation and the table is locked in position. A slide 41 is guided in the plate 37 and is provided with a rearwardly-extending projection or arm 42, which is arranged to engage the plate 40. When the gear 38 is moved in either direction to move the clutch 14 into engagement with either the gear 16 or 17, and thus throw the automatic feed into operation, the plate 40 is rocked into an inclined position and lifts the slide 41 into the path of a dog 43, adjustably secured in an undercut groove formed in the edge of the table. When the dog 43 engages the slide 41, said slide is forced down and the arm 42 acts upon the plate 40 and moves said plate into a horizontal position, thus moving the clutch 14 out of engagement and arresting the movement of the table.

In order that the table may be quickly returned to its initial position after each cut when the machine is operating to cut in one direction only and also to enable large adjustments of the table to be quickly made, means are provided for manually operating the table, which are as follows: A beveled gear 44 is formed upon the under face of the worm-wheel 31 and is engaged by a beveled gear 45, formed upon the end of a sleeve 46, journaled in the bracket 12. A rod 47, suitably journaled in the knee 1, passes through the sleeve 46 and is connected therewith by means of a key 48, which slides in a slot 49, formed in said rod when the saddle is adjusted. The rod 47 is provided with a squared end at the front of the knee adapted to receive a removable handle or crank for turning the same. In order to enable the rod 47 to be turned to operate the pinion 10, it is necessary that the worm 30 should be out of

engagement with the worm-wheel 31, as otherwise the worm-wheel will be prevented from turning by said worm. Accordingly the bearings of the shaft 27 are so connected with the saddle that said shaft may be moved to throw the worm out of engagement with the worm-wheel. In the form shown the bearing 28 is pivoted at 50, and the bearing 29 is pivotally connected to a slide 51, mounted in a bracket 52, depending from the saddle. The slide 51 is provided with a slot engaged by a pin 53, projecting from the end of a stud 54. A handle 55 is secured to the end of stud 54 for turning the same to throw the worm into or out of mesh with the worm-wheel. The end of a screw 56 projects into an annular groove formed in stud 54 and prevents longitudinal movement thereof, and a spring locking-pin 57 engages recesses in said stud and serves to hold said stud at either limit of its throw. When the handle 55 is swung forward, the bearing 28 is swung on its pivot 50, so as to throw the worm 30 out of engagement with worm-wheel 31, but the movement is not sufficient to throw the gear 26 out of engagement with the gears 16 and 17.

It is frequently desirable to manually move both the saddle and the table simultaneously, which is not possible with the mechanism thus far described, for the reason that the rods 6 and 47 are too near together, and in order to enable this to be conveniently done the machine is provided with table-operating means which is adjacent to the rod 6 and which is so arranged that it may be operated simultaneously therewith. It is also desirable that the table should be slowly and accurately moved at such times, and it is accordingly preferred to so connect this table-operating means that it shall give a fine feed to the table, and one manner of so connecting said means is shown in the drawings and is as follows: A pinion 58 is secured to the hub of gear 17 and is engaged by a gear 59, secured to a shaft 60, mounted in the saddle. The shaft 60 extends beyond the front of the saddle and is provided with a squared end adapted to receive a removable handle or hand-wheel 61. The shaft 60 is thus conveniently located at the front of the machine adjacent to the rod 6 for operating the saddle, and the operator can readily operate both shafts simultaneously whatever may be the relative positions of the saddle and table.

The rack 110 may be formed of a single piece, if desired, but it is preferred to form said rack in two sections and to provide means for taking up the backlash between said rack and pinion 10. In the form shown the rack 110 consists of two sections 110^a and 110^b, and means are provided for yieldingly forcing said sections out of alinement in either direction. The section 110^b has secured thereto two oppositely-disposed plates 62 63, provided with laterally-projecting portions 64 65, overlying the section 110^b and forming oppositely-arranged abutments. Intermediate the abutments 64 65 is a third abutment in the form of a block 66, engaged by a screw-rod 67, which is journaled in a bearing 68, secured to the table 8. Springs 69 70 are interposed between the block 66 and the abutments 64 65, which abutments may be recessed, as shown, to receive said springs. By turning the rod 67 the block 66 may be adjusted to compress either of the springs 69 70, and thus force the teeth of section 110^b out of alinement with the teeth of section 110^a in either direction, and thus prevent backlash between rack 110 and pinion 10, the teeth of the sections being forced out of alinement in one direction or the other according to the direction in which the table is being fed. While the device for taking up backlash is shown as applied to a rack, it is obvious that it may be readily applied to any other form of toothed member, and that this feature of the invention is not limited to a rack, but is of general application.

The general operation of the mechanism described is as follows: The shaft 15 is continuously driven by suitable connections, as before described, and the clutch 14 is therefore continuously revolved. When it is desired to feed the table automatically to the right, the clutch is shifted by means of the handle 39 into engagement with the gear 17, thus causing said pinion to be revolved. The gear 17 acting through the gear 26, shaft 27, worm 30, worm-wheel 31, stud 11, pinion 10, and rack 110 now feeds the table, the gear 16 running idly in its bearing. By shifting the clutch into engagement with gear 16 the table will be similarly fed in the opposite direction. If it is desired to throw the automatic feed out of operation automatically when the table arrives at a certain point, the dog 43 is adjusted into the proper position and operates upon the slide 41 to throw the clutch into the position shown in Fig. 2 out of engagement with the gears 16 and 17, at which time the table is securely held from any accidental movement by the worm 30 and worm-wheel 31. It will thus be seen that the direction of the automatic feed for the table may be quickly and conveniently reversed or thrown out of operation without interrupting the operation of the other parts of the machine, and that when thrown out either by hand or automatically the table will be securely held or locked in position. When it is desired to feed both the saddle and the table by hand, the clutch is thrown into the position shown in Fig. 2, and operating-handles are placed upon rod 6 and shaft 60, and the operator operates one of these handles with each hand. When it is desired to quickly return the table to its initial position or to quickly move the table in adjusting the work, the worm 30 is thrown out of engagement with the worm-wheel 31 by throwing the handle 55 forward, and the table is moved by means of an operating-handle placed upon the end of shaft

47. When a fine and accurate adjustment of the table is desired, it may be obtained by operating the table through the shaft 60.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In a milling-machine, the combination with the table, of a feed therefor, embodying a rack secured to said table and a pinion engaging said rack, means for automatically throwing said feed out of operation, and means for locking said table in position when said feed is thrown out, substantially as described.

2. In a milling-machine, the combination with the table, of a feed therefor, embodying a rack secured to said table and a pinion engaging said rack, means controlled by the movement of the table for throwing said feed out of operation, and means for locking said table in position when said feed is thrown out, substantially as described.

3. In a milling-machine, the combination with the table, of a feed therefor, embodying a rack secured to said table and a pinion engaging said rack, means for reversing the direction of said feed, means for automatically throwing said feed out of operation, and means for locking said table in position when said feed is thrown out, substantially as described.

4. In a milling-machine, the combination with the table, a rack secured thereto, and a pinion engaging said rack, of means for operating said pinion, means for automatically throwing said operating means out of operation, and means for locking said table in position when said operating means is thrown out, substantially as described.

5. In a milling-machine, the combination with the table, a rack secured thereto, and a pinion engaging said rack, of means for operating said pinion, means controlled by the movement of the table for throwing said operating means out of operation, and means for locking said table in position when said operating means is thrown out, substantially as described.

6. In a milling-machine, the combination with the table, a rack secured thereto and a pinion engaging said rack, of a driver for said pinion, a worm-wheel connected with said pinion, a worm engaging said worm-wheel, and connected with said driver, and means for automatically throwing said driver out of operation, substantially as described.

7. In a milling-machine, the combination with the table, a rack secured thereto, and a pinion engaging said rack, a worm-wheel connected with said pinion, a worm engaging said worm-wheel, means comprising a clutch for driving said worm, and means for automatically throwing said clutch out of operation, substantially as described.

8. In a milling-machine, the combination with the table, a rack secured thereto, a pinion engaging said rack, of a worm-wheel connected with said pinion, a worm engaging said worm-wheel, a gear connected with said worm, gears upon opposite sides of said former gear, and means for driving either of said gears in the same direction, substantially as described.

9. In a milling-machine, the combination with the table, a rack secured thereto, and a pinion engaging said rack, of a worm-wheel connected with said pinion, a worm engaging said worm-wheel, a gear connected with said worm, two gears meshing with said gear, and a clutch for driving either of said gears, substantially as described.

10. In a milling-machine, the combination with a saddle, and means for manually operating the same, of a table mounted on said saddle, a rack secured to said table, a pinion engaging said rack, and means for manually operating said pinion arranged to be operated simultaneously with the saddle-operating means, substantially as described.

11. In a milling-machine, the combination with a saddle, and means for manually operating the same, of a table mounted on said saddle, a shaft projecting from the front of the saddle, and gearing comprising a worm and worm-wheel for connecting said shaft with the table, substantially as described.

12. In a milling-machine, the combination with a table, a rack secured thereto, a pinion engaging said rack, means for operating said pinion in either direction, a driver for said means and means for shifting said driver to change the direction of the feed.

13. In a milling-machine, the combination with a saddle, and a table mounted thereon, of a rack secured to said table, a pinion engaging said rack, means for operating said pinion in either direction, and means carried by the saddle for changing the direction of the feed, substantially as described.

14. In a milling-machine, the combination with a table, a rack secured thereto, a pinion engaging said rack, means for operating said pinion in either direction, a clutch for driving said operating means, and means for shifting said clutch, substantially as described.

15. In a milling-machine, the combination with a saddle, and a table mounted thereon, of a rack secured to said table, a pinion engaging said rack, means for operating said pinion in either direction, a driver for said means and means carried by the saddle for shifting said driver to change the direction of the feed, substantially as described.

16. A toothed member formed in sections and means for yieldingly forcing said sections out of alinement in either direction, substantially as described.

17. A toothed member formed in sections, springs for forcing said sections out of alinement in either direction, and means for energizing either of said springs, substantially as described.

18. A toothed member formed in sections, two oppositely-disposed abutments upon one section, an abutment between said former abutments, springs interposed between the

former abutments and the intermediate abutment, and means for adjusting distance between the abutments, substantially as described.

19. A toothed member formed in sections, oppositely-disposed abutments upon one section, an intermediate abutment between said abutments, springs between the abutments and means for adjusting the intermediate abutment, substantially as described.

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EDWIN P. ALLEN.