No. 680,482. Patented Aug. 13, 1901.

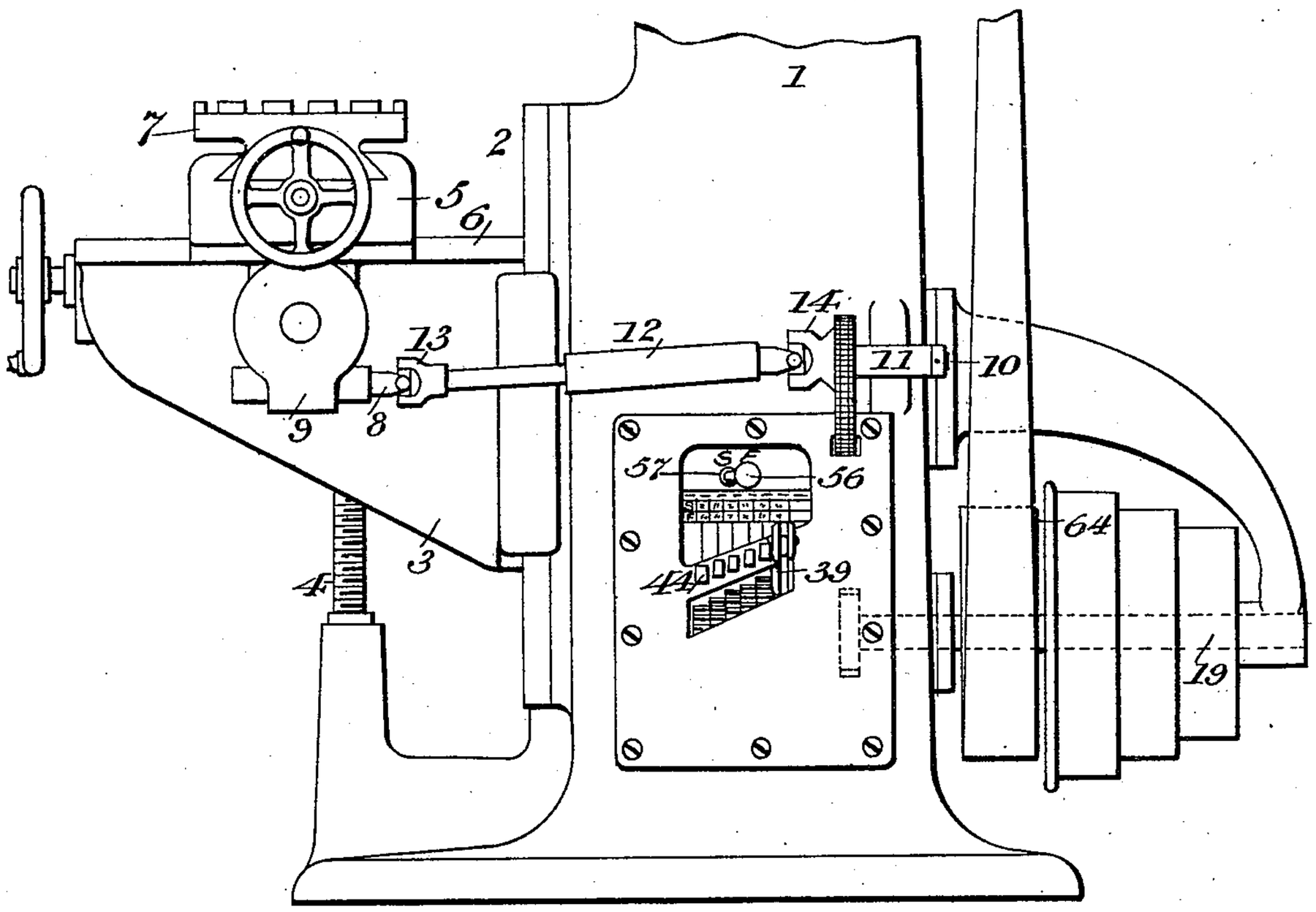
C. R. GABRIEL.

MILLING MACHINE.

(Application filed Mar. 1, 1899.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.



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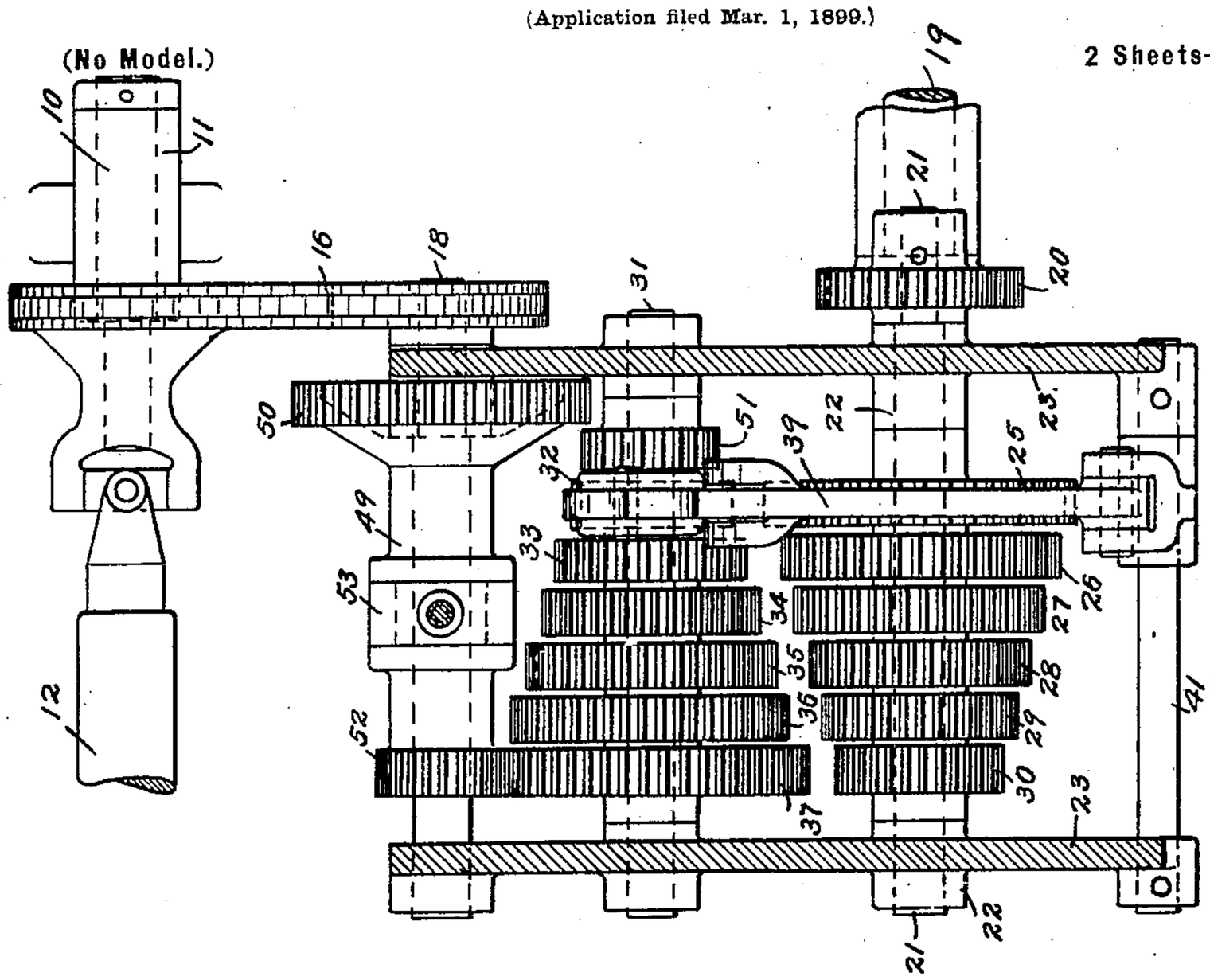

FIG. 3.

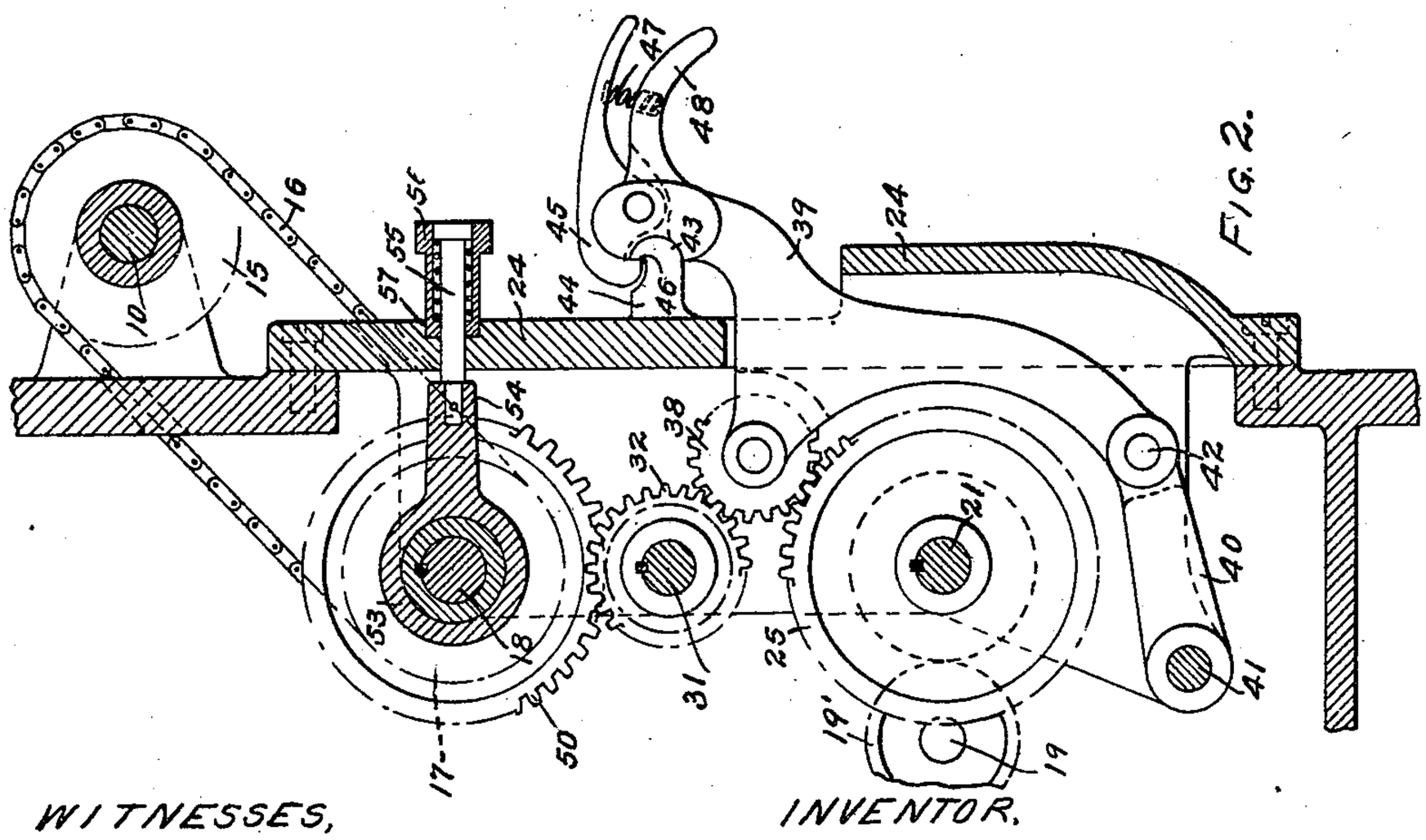

FIG. 2.

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MILLING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 680,482, dated August 13, 1901.

Application filed March 1, 1899. Serial No. 707,298. (No model.)

To all whom it may concern:

Be it known that I, CHARLES R. GABRIEL, of the city and county of Providence and State of Rhode Island, have invented certain new and useful Improvements in Variable-Speed Mechanism; and I do hereby declare the following specification, taken in connection with the accompanying drawings, forming a part of the same, to be a full, clear, and exact description thereof.

The mechanism embodying the present invention comprises two oppositely-disposed cone-gears arranged on parallel axes, and preferably in inverse relation, so that the smallest gear of one cone is in the same plane with the largest gear of the other cone. These cones are connected by an intermediate gear, which may be shifted laterally to connect any two corresponding gears of the two cones, and the speed of the driven cone depends upon the relative sizes of the gears connected by the intermediate gear. In order that the gearing thus connected may run smoothly and without undue wear or danger of becoming disconnected, the intermediate gear should be held or locked in its adjusted positions, so that it will not be drawn inward toward the cone-gears or forced outward away from the cone-gears by the action of the driving-cone. In the former case the intermediate would be wedged in between the cone-gears, causing the gears to bend and wear, and in the latter case the intermediate gear might be thrown out of engagement with the cone-gears. One feature of the present invention accordingly comprises means for locking the adjustable intermediate gear in its adjusted positions, so that when once adjusted said gear becomes substantially a fixed gear and will run as smoothly and with as little wear or danger of becoming disengaged as if it were mounted on a fixed shaft. In the preferred embodiment of the invention the intermediate gear is made laterally adjustable by mounting the same upon an arm pivotally supported, so that it may be moved toward and from the cone-gears and also mounted to slide laterally to bring the intermediate gear into the plane of any two corresponding gears of the two cones. In this embodiment of the invention the intermediate is secured or locked in its adjusted positions by securing the carrying-arm in fixed relation to the cone-gears after the intermediate gear has been brought into the proper position to engage and run smoothly with the cone-gears. The preferred means for thus securing the arm consists of a series of lugs corresponding to the different positions of the intermediate gear, to any one of which the arm may be latched. These lugs, preferably, are arranged to overlap and to hold the arm from lateral as well as pivotal movement. With this construction the intermediate gear may be quickly and conveniently adjusted by merely disengaging the arm from one lug and engaging it with another, and the intermediate gear will by this manipulation be positioned or brought into the proper relation with the desired cone-gears and be held in this relation without any danger of wedging or binding or of being disengaged by the action of the driving-cone in overcoming the resistance of the driven cone.

In explaining more fully one form of mechanism in which the invention may be embodied a mechanism will be described which is designed more especially for milling-machines, although this mechanism or other forms embodying the invention may be used in other classes of machines where variations in speed are desired.

Referring to the drawings, Figure 1 is a side elevation of a vertical-spindle milling-machine embodying the present improvements in their preferred forms. Fig. 2 is a side elevation of the mechanism for varying the feed. Fig. 3 is a front elevation of the same.

Referring to the drawings in detail, 1 indicates the frame of a vertical-spindle milling-machine in which the present improvements are embodied. The frame 1 is provided with vertical ways 2, on which is mounted the knee 3, which is adjusted by means of the screw 4 in any well-known manner. The usual saddle 5 is mounted on ways 6 on the knee, and the table 7 is mounted for longitudinal movement on the saddle in a well-known manner. The table is connected by any suitable and well-known mechanism with the shaft 8,

mounted in a suitable bearing 9, secured to the saddle, the connections being such that when the shaft 8 is revolved motion is imparted to the table. The shaft 8 is connected to a shaft 10, mounted in a bearing 11 on the frame, by means of a telescoping shaft 12, one end of which is connected with shaft 8 by a universal joint 13 and the other end to shaft 10 by a similar joint 14. The shaft 10 is provided with a pulley 15, engaged by a belt or chain 16, which also passes over a pulley 17, secured to a shaft 18. By varying the speed of shaft 18 the feed of the table may be varied, and the mechanism embodying the present invention is employed in the machine shown for effecting variations in the speed of said shaft, the variable-speed mechanism being interposed between the shaft 18 and the driving-shaft 19 in the following manner:

The shaft 19 carries a gear 19′, which meshes with a similar gear 20, secured to a shaft 21, mounted in bearings 22. The bearings 22 are carried by plates 23, extending inward from a plate 24, secured to the frame 1. A series of gears 25 to 30, of varying diameter, are secured to the shaft 21 and form a cone-gear. A second shaft 31 is mounted in bearings carried by the plates 23 and carries a series of gears 32 to 37 secured thereto, which form a cone-gear arranged with its largest gear 37 in the same plane with the smallest gear 30 of the cone-gear carried by shaft 21. In the construction shown there are six gears of differing diameter on each shaft, and the shaft 31 may be driven at any one of six different speeds by connecting the proper gears. Any two corresponding gears may be connected by means of an intermediate gear 38, which is secured to a short shaft mounted in an arm 39. The arm 39 is pivoted at 42 to a link 40, which is mounted to slide on a rod 41, so that the arm 39 may be moved laterally to bring the gear 39 into the plane of any two corresponding gears on shafts 21 and 31. The link 40 is preferably of such a length that the center of the pivot 42 will move in a path corresponding to the curve which would be plotted by the successive positions of the axis of gear 38 as it connects successive pairs of gears in the two cone-gears, with the result that the successive positions of the arm 39 are parallel to each other. The arm 39 is held or locked in any of its adjusted positions by being latched to one of a series of lugs 44, which, as shown, are arranged on the outer surface of the plate 24, where they may be conveniently seen and reached by the operator. Each lug corresponds to a pair of gears in the cone-gears and determines the position of the intermediate gear when in engagement therewith. The arrangement is preferably such that the lugs will overlap, so that the arm 39 will be held from lateral movement on any lug by the next adjoining lugs. When the arm is in engagement with either of the end lugs, lateral movement in one direction may be prevented by the limited play of the arm 40 on the rod 41. In the mechanism shown the lugs are shaped to fit a semicircular recess 43, formed in the arm 39, and the arm is latched to the lug by means of a catch 45, pivoted to the arm and arranged to engage a shoulder 46 on the lug. The catch 45 is preferably operated by a spring 47, and for convenience of manipulation its rear end overlies the handle 48, by which the arm 39 is moved in adjusting the intermediate gear to change the speeds.

Any suitable gearing may be used for connecting the shaft 31 with shaft 18; but it is preferred to use for this purpose a quill-gear formed of the gears 50 and 52, connected by the sleeve 49. This quill-gear is keyed to slide on the shaft 18, the gear 50 being arranged to engage a gear 51, secured to shaft 31, and the gear 52 being arranged to engage gear 37. The distance between gears 50 and 52 is such that when gear 50 is engaged with gear 51 the gear 52 is out of mesh with gear 37, and when gear 52 is in mesh with gear 37 the gears 50 and 51 are out of mesh. By this arrangement of gearing the number of variations in the speed of shaft 18 relative to shaft 21 is doubled—that is to say, with the construction shown in which the cone-gears have six steps the shaft 18 may be driven at any one of twelve different speeds. The sleeve connecting the gears 50 and 52 is provided with an annular recess in which a ring 53 is mounted, said ring being provided with a laterally-extending arm 54. A pin 55 is secured in said arm and passes through a slot in plate 24. A spring-pressed sleeve 56 surrounds the pin outside the plate 24 and forms a handle for adjusting the quill-gear and also serves to hold the gear in its adjusted positions by engaging one of two recesses 57, formed in plate 24.

With the parts in the position shown the gear 25 is connected with gear 32 by the intermediate gear 38, and shaft 31 is driven at its highest speed relative to shaft 21. The gear 52 engages gear 37, and shaft 18 therefore is driven at its highest speed relative to shaft 31, and the table will be given its coarsest feed. If it is desired to reduce the speed of shaft 18, the catch 45 is disengaged and the arm 39 moved laterally and downward to bring gear 38 into mesh with, say, gears 33 and 26 and the catch then engaged with the corresponding lug 44. By adjusting the quill-gear to bring gears 50 and 51 into mesh the speed of shaft 18, and consequently the feed of the table, may be changed without changing the gear 38. It will be understood that the amount of feed for one revolution of the cutter-spindle may be calculated and a table made showing the amount of feed for each adjustment of the gear 38 and the quill-gear. It will be understood that the quill-gear may be omitted if only a comparative small number of variations in feed are desired.

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

1. The combination with two oppositely-disposed cone-gears, of a laterally-adjustable intermediate gear for connecting any two corresponding gears of said cone-gears, and means for positioning said intermediate gear and securing said gear in its adjusted position.

2. The combination with two oppositely-disposed cone-gears, of an intermediate gear for connecting any two corresponding gears of said cone-gears, a pivotally-mounted and laterally-movable arm on which said gear is mounted, and means for holding said arm against pivotal or lateral movement in each of its adjusted positions.

3. The combination with two oppositely-disposed cone-gears, of an intermediate gear for connecting any two corresponding gears of said cone-gears, an arm on which said gear is mounted, a series of lugs arranged to be engaged by said arm, and means for securing said arm to any of said lugs.

4. The combination with two oppositely-disposed cone-gears, of an intermediate gear for connecting any two corresponding gears of said cone-gears, an arm on which said gear is mounted, a series of overlapping lugs arranged to be engaged by said arm, and means for securing said arm to any of said lugs.

5. The combination with a driving-shaft, of a cone-gear secured thereto, a driven shaft, a cone-gear secured thereto, an intermediate gear for connecting any two corresponding steps of said cone-gears, a pivotally-mounted and laterally-movable arm carrying said intermediate gear, and means for securing said arm in its adjusted positions, substantially as described.

6. The combination with a driving-shaft, of a cone-gear secured thereto, a driven shaft, a cone-gear secured thereto, an intermediate gear for connecting any two corresponding steps of said cone-gears, an arm carrying said intermediate gear, a laterally-sliding link to which said arm is pivoted, and means for securing said arm in its adjusted positions, substantially as described.

7. The combination with a driving-shaft, of a cone-gear secured thereto, a driven shaft, a cone-gear secured thereto, an intermediate gear for connecting any two corresponding steps of said cone-gears, a laterally-movable arm carrying said intermediate gear, a catch on said arm, and a series of shoulders arranged to be engaged by said catch, substantially as described.

8. The combination with a driving-shaft, of a cone-gear secured thereto, a driven shaft, a cone-gear secured thereto, an intermediate gear for connecting any two corresponding steps of said cone-gears, a laterally-movable arm carrying said intermediate gear, a recess in said arm, a series of lugs having surfaces for engaging said recess-shoulders on said lugs, and a catch on said arm for engaging said shoulders, substantially as described.

9. The combination with a driving-shaft, of a cone-gear mounted thereon, a driven shaft, a cone-gear mounted thereon, means for throwing any two corresponding steps of said gears into action, a longitudinally-movable quill-gear, gears on said driven shaft arranged to be engaged by the gears of said quill-gear, and a shaft driven by said quill-gear, substantially as described.

10. The combination with a driving-shaft, of a cone-gear secured thereto, a driven shaft, a cone-gear secured thereto, an adjustable intermediate gear for connecting any two corresponding steps of said cone-gears, a longitudinally-movable quill-gear, gears on the driven shaft arranged to be engaged by the gears of the quill-gear, and a shaft driven by the quill-gear, substantially as described.

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