May 8, 1923. 1,454,181

F. MÜLLER

MECHANISM FOR MILLING BLANKS FOR CUTTERS

Original Filed July 20, 1918 3 Sheets-Sheet 1

Fig. 1.

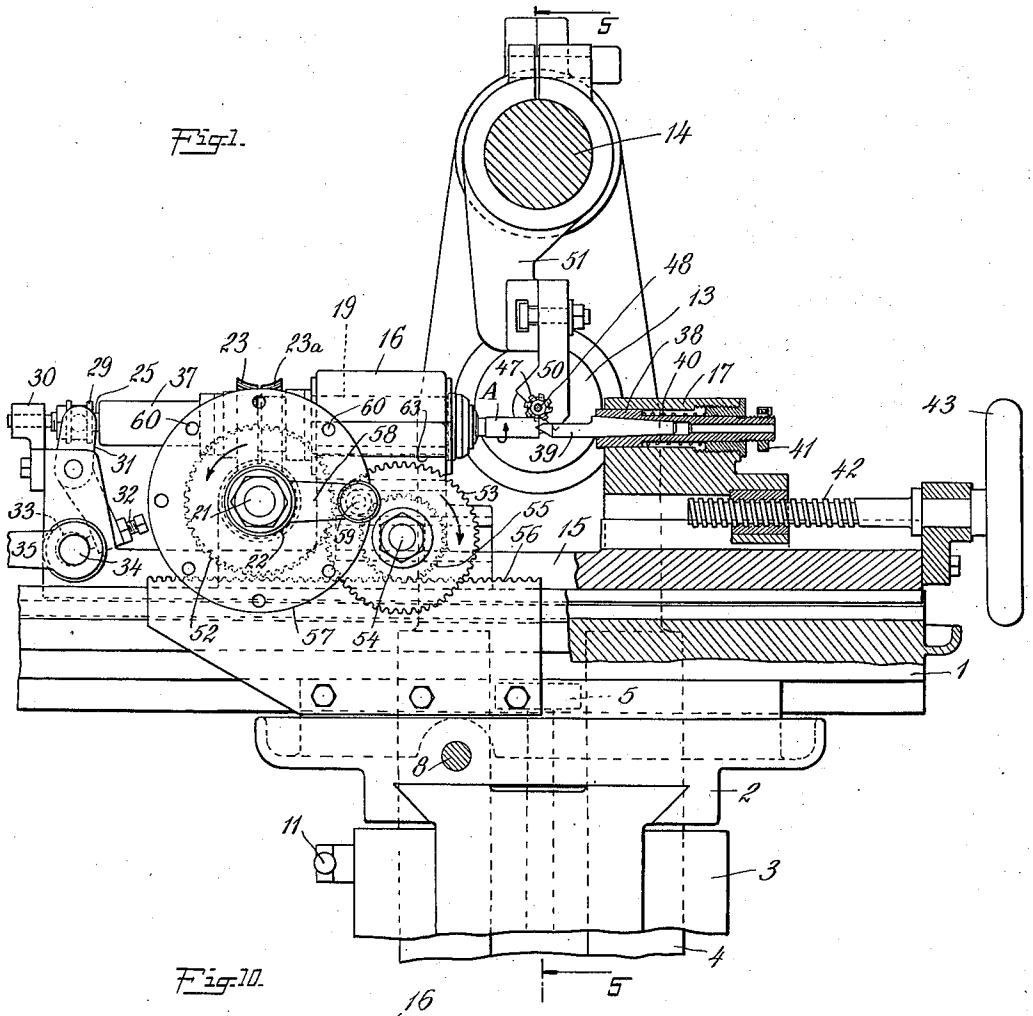
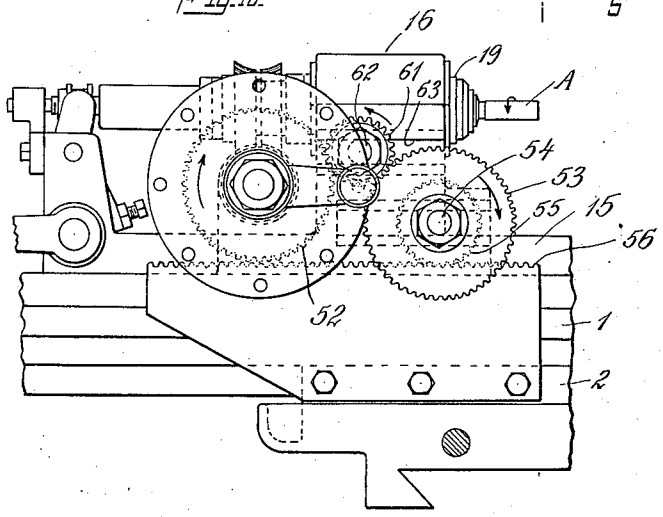


Fig. 10.



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Fig. 2.

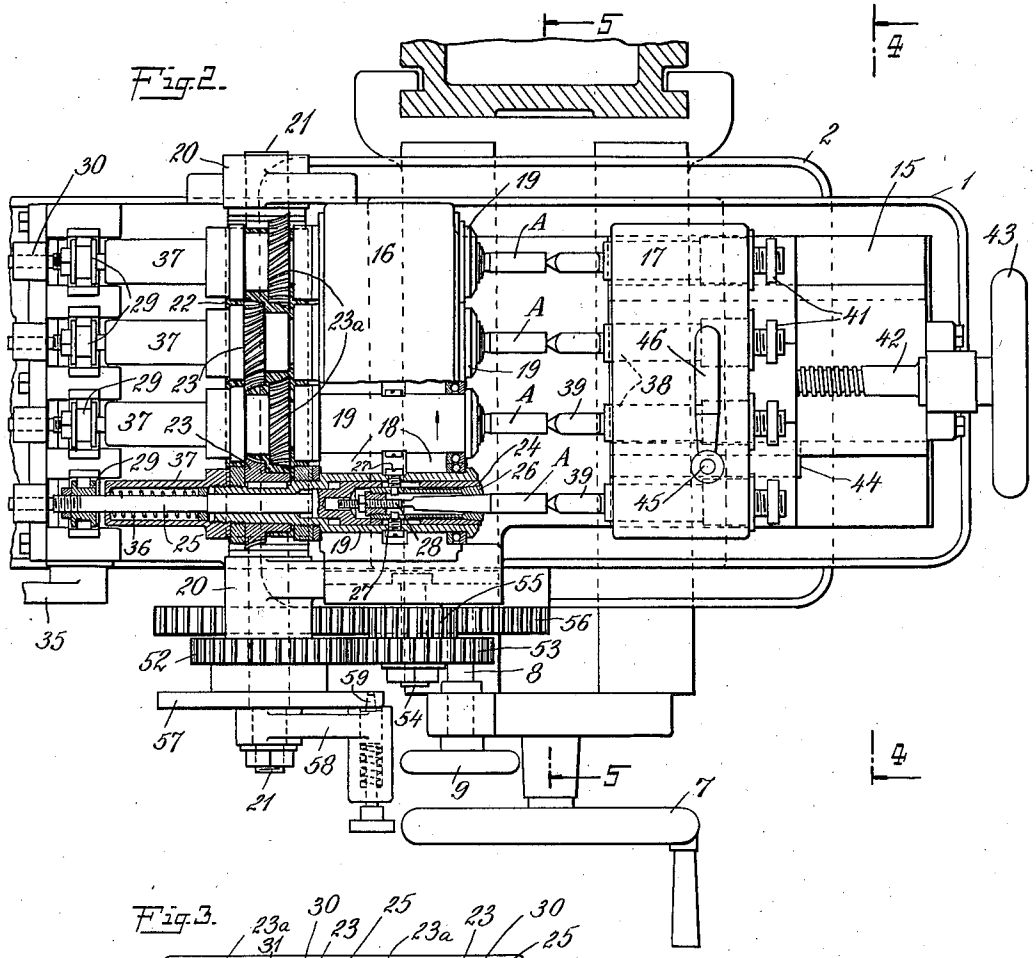


Fig. 3.

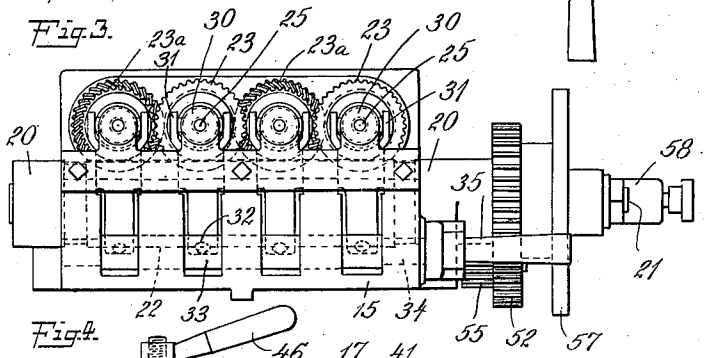
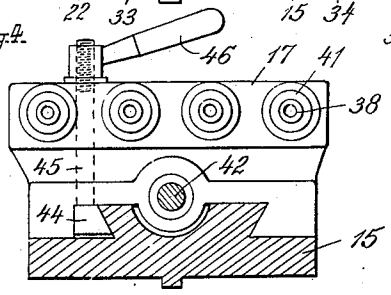


Fig. 4.



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Fig. 5.

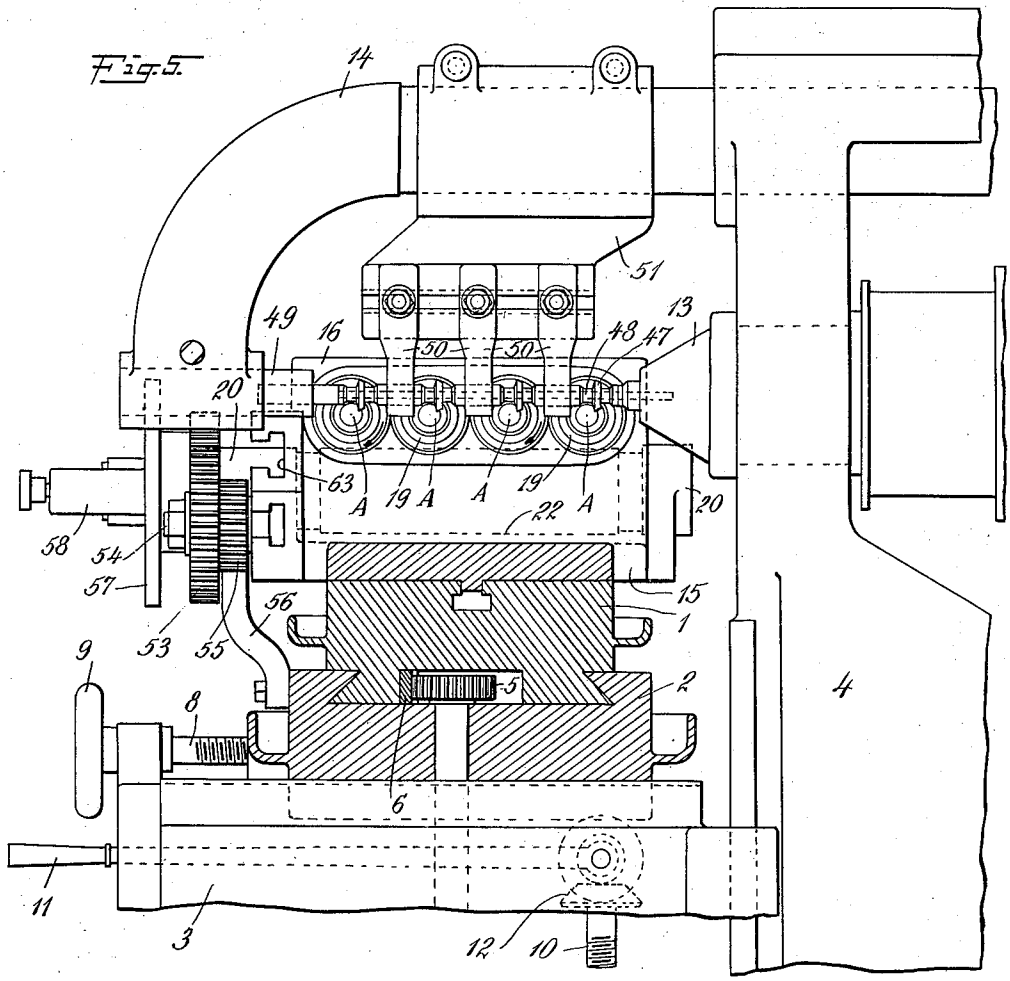


Fig. 6.

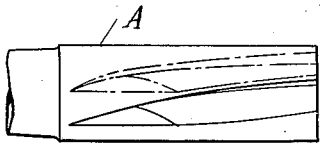


Fig. 7.

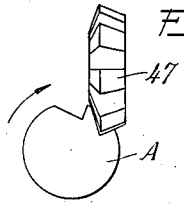


Fig. 8.

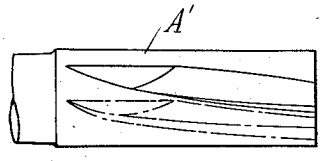
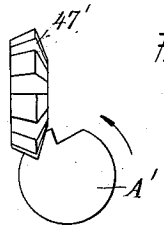


Fig. 9.



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UNITED STATES PATENT OFFICE.

FRIEDERICH MÜLLER, OF HARTFORD, CONNECTICUT, ASSIGNOR TO PRATT & WHITNEY COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW JERSEY.

MECHANISM FOR MILLING BLANKS FOR CUTTERS.

Application filed July 20, 1918, Serial No. 245,861. Renewed October 6, 1921. Serial No. 505,927.

To all whom it may concern:

Be it known that I, FRIEDERICH MÜLLER, a citizen of the United States, residing at Hartford, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Mechanism for Milling Blanks for Cutters, of which the following is a specification.

The invention relates particularly to a mechanism for milling helical grooves in blanks for end mills or other milling cutters.

One of the objects of the invention is to provide an improved apparatus whereby helical grooves in a plurality of such blanks may be milled simultaneously. A further object of the invention is to provide an improved mechanism for the purpose set forth which is adapted to serve as an attachment for a previously or separately constructed milling machine of standard form. Further objects of the invention will be apparent from the following specification and claims.

In the accompanying drawings I have shown one embodiment of the invention but it will be understood that the drawings are merely for illustrative purposes and that the invention can be embodied in other ways without departing from the spirit thereof as set forth in the claims appended to this specification. Particularly it will be understood that, if preferred, the mechanism may be constructed as a permanent part of a milling machine instead of as an attachment therefor.

Of the drawings:

Fig. 1 is a side view, partly in section, of a mechanism embodying the invention.

Fig. 2 is a plan view with certain parts broken away and others shown in section.

Fig. 3 is an end view taken from the left.

Fig. 4 is a transverse sectional view taken along the line 4—4 of Fig. 2.

Fig. 5 is a transverse view, partly in section, along the line 5—5 of Fig. 1.

Figs. 6 and 7 are diagrammatic views, on an enlarged scale, showing the milling of left-hand grooves in a cutter blank.

Figs. 8 and 9 are diagrammatic views, on an enlarged scale, showing the milling of right-hand grooves in a cutter blank.

Fig. 10 is a fragmentary side view, similar in part to Fig. 1, but showing the mechanism adjusted for the milling of right-hand grooves instead of left-hand grooves.

The illustrated embodiment of the invention consists of a milling machine attachment which is cooperative with the usual milling machine parts. It is to be understood, however, that the invention can be differently embodied so as to constitute a complete unitary machine.

I have illustrated parts of a horizontal milling machine of standard construction. As shown, there is a table 1 which is longitudinally movable on a saddle 2. The saddle is transversely movable on a knee 3, which is vertically adjustable with respect to the main milling machine frame 4. The longitudinal movement of the table 1 along the saddle 2 is effected in any usual or preferred way by suitable mechanism including a pinion 5 engaging a rack 6. The table is ordinarily moved by power, but in order that it may be moved manually when desired, there is provided a hand wheel 7. The usual devices are provided whereby the feed may be started manually and then stopped automatically at any predetermined point. The saddle 2 is transversely adjustable on the knee by means of a screw 8 operable by a hand wheel 9. The knee is vertically adjustable by means of a screw 10, operable by a lever 11 which is connected with the screw through bevel gearing 12. The milling machine has a horizontal driving spindle 13 and an adjustable overarm 14.

The attachment to which the invention particularly relates comprises a main frame 15 which is adapted to be rigidly secured to the table 1 of the milling machine. Mounted on the frame 15 is a multiple headstock 16 and a multiple tailstock 17 for holding a plurality of blanks A to be milled. As illustrated, the headstock and tailstock are adapted for holding four blanks, but it will be understood that the number may be varied.

The headstock 16 comprises bearings 18, 18 in which are mounted four similar parallel spindles 19, 19, the spindles preferably being arranged longitudinally with their axes in a single horizontal plane. Rotatably mounted in suitable bearings 20, 20 carried

by the frame 15 is a transverse shaft 21 upon which is mounted a long worm 22. Carried respectively by the spindles 19, 19 are worm wheels 23, 23 and 23^a, 23^a. It will be noted that these worm wheels are relatively narrow and are located respectively at opposite sides of the central plane of the worm. The wheels are arranged alternately, the wheels 23 at one side of the said central plane being on the first and third spindles and the wheels 23^a on the other side of the central plane being on the second and fourth spindles. This staggered arrangement of the worm wheels enables me to place the spindles much closer together than would otherwise be possible.

Each spindle 19 is hollow and has mounted within it at its outer end a collet chuck for engaging the shank B of the blank A to be milled. The shanks are usually tapered and I therefore provide a chuck adapted to engage a tapered shank. As illustrated, there is mounted within the spindle 19, a longitudinally slidable sleeve 24 which terminates at the rear in a rod 25. Located within the sleeve 24 is a split bushing 26 which is tapered at its outer end to engage with a similarly tapered portion of the sleeve 24. This bushing 26 is adapted to receive and engage the shank B. The bushing is held against longitudinal movement by means of opposite pins 27, 27 which extend inward from the main body of the spindle. The sleeve 24 is suitably slotted so that the pins 27, 27 will not interfere with the longitudinal movement thereof. Carried by the bushing 26 at the inner end thereof is a stop screw 28 which is adjustable. This stop serves to limit the inward movement of the shank.

The rod 25 projects outward at the rear of the spindle and carries a grooved collar 29. The extreme outer end portion of the rod is supported by a bearing 30. A forked lever 31 is pivotally mounted on the frame 15 and is provided with pins fitting the groove of the collar 29. The lower end of the lever 31 carries an adjustable screw 32 the end of which engages an eccentric 33. The eccentrics 33 for all of the spindles are mounted on a transverse shaft 34 which is operable by means of a hand lever 35. A spring 36 surrounds each rod 25 and tends to move it inward toward the right. Each spring is enclosed in a bushing 37 the outer end of which serves as an abutment for one end of the spring.

The drawings show the chucks closed and in engagement with the shanks B. When the blanks are to be removed and new blanks inserted, the handle 35 is turned to move the eccentrics 33 and thus swing the levers 31 in the counter-clockwise direction. This movement serves to withdraw the rods 25 backward toward the left against the action of the springs 36. This backward movement of the rods 25 causes the withdrawal of the sleeves 24, thus permitting the bushings 26 to expand and release the shanks B. The blanks can then be removed manually and new blanks put in place with their inner ends abutting against the stops 28. When the new blanks are all in place, the operator returns the handle 35 to the position shown, thus permitting the rods 25 and sleeves 24 to move toward the right under the influence of the springs 36. This movement of the sleeves forces the bushings 26 into firm engagement with the shanks of the blanks. It will be observed that the split bushings 26 are fixed against longitudinal movement as are also the stops 28. The opening and closing of the chucks is effected solely by the sleeves 24 which do not engage the blanks. For this reason it is impossible for any longitudinal movement of the blanks to take place as the result of the closing action of the chucks. The chucks thus serve to accurately hold the blanks in predetermined positions.

The tailstock 17 comprises four spindles 38, 38 carrying centers 39, 39 respectively alining with the spindles 19, 19 of the headstock. Each spindle 38 is longitudinally slidable in the tailstock casting and is movable toward the left by means of a coil spring 40. A nut 41 at the rear of the spindle serves to limit the movement thereof under the action of the spring. The tailstock as a whole is longitudinally movable along suitable ways on the frame 15. For moving the tailstock there is provided a longitudinal screw 42 operable by a hand wheel 43. The screw 42 is fixed against longitudinal movement with respect to the frame and engages a nut secured to the tailstock. It will be seen that the operator, by turning the hand wheel, can move the tailstock forward or backward as desired. The tailstock can be locked in adjusted position by means of a gib 44 which is adapted to be tightened by means of a screw 45 and a lever 46. In practice, use is made of the tailstock and of the centers 39, 39 thereof for moving the blanks into the chucks and for holding them in engagement with the stops 28, 28 thereof. When the finished blanks are to be removed the tailstock is loosened and is drawn back. Then the blanks are taken out manually and the new blanks inserted. After that the tailstock is returned to the position shown, the centers 39, 39 engaging the blanks and pushing them into the chucks. The blanks may vary slightly in length and the holes therein for the centers 39, 39 may vary slightly in depth. These variations are taken care of by the springs 40. When the tailstock is moved forward toward the left the centers move the blanks toward the left until they

engage the stops 28, whereupon the springs 40 yield to permit further movement of the tailstock toward the left. After the tailstock has been moved far enough to properly tension the springs, it is locked in position by means of the gib 44 and the lever 46.

Cutters 47 for milling the blanks A are mounted on an arbor 48 which is suitably connected with the spindle 13 of the milling machine. The outer end of the arbor is supported by a bearing 49 carried by the overarm 14. The cutters must be quite small in diameter, and for this reason a small arbor must be provided. A small arbor such as shown would not of itself have sufficient strength and rigidity to properly support the cutters in operative relation with the blanks. I therefore provide supporting bearings 50, 50 positioned respectively between each two cutters and engaging the arbor at one side thereof. These bearings are adjustably connected with a bracket 51 which is clamped to the overarm. As shown in Fig 1, each bearing 50 engages the arbor on one side thereof only, the position of contact being such as to withstand the reaction of the cutting operation.

To effect the milling of grooves in the outer surfaces of the blanks, the table 1, with the various parts carried thereby, is moved longitudinally by the usual power feed mechanism of the milling machine. My improved mechanism is primarily intended for the milling of helical grooves and when such grooves are to be milled it is obviously necessary to turn the blanks as they are moved forward. For turning the blanks I make use of the aforesaid worm 22 which has been heretofore described as meshing with the worm wheels 23, 23 and 23^a, 23^a. Connected with the shaft 21 at its front end is a gear 52 which meshes with a gear 53 mounted on a stud 54. Also mounted on the stud 54 and connected with the gear 53 is a gear 55 which meshes with a horizontal rack 56. This rack is suitably secured to the saddle 2 so as to be fixed against longitudinal movement with the table 1. It will be seen that when the table 1 and the parts carried thereby including the cutter blanks are moved toward the right, the gear 55 will roll along the rack 56 causing the gear 53 to rotate in the clockwise direction. The gear 52 together with the worm 22 will be rotated in the counter-clockwise direction, thus causing the spindles 19 with the blanks A to rotate in the clockwise direction as viewed in Fig. 5. This rotative movement of the blanks is in exact proportion to the longitudinal movement thereof, thus causing the cutting of helical grooves. The angle of inclination of the grooves can be changed by removing the gear 53 and substituting another gear of different diameter. The stud 54 is adjustably held in a slot in the frame 15 and is thus adapted for holding gears of different diameters.

When the blanks are first put in place the table is in a position to hold the blanks with their right-hand ends near the cutters. To cut the first groove the automatic feed mechanism of the milling machine is started and this feed mechanism is adjusted to automatically effect stopping when a groove has been cut along the blank for the required distance. It will be observed that the rack 56 is of sufficient length to permit of considerable variation in the initial position of the table 1 and of the parts carried thereby.

After the feed has stopped automatically, the table is manually moved toward the left. It will be understood that during this movement of the table toward the right the blanks are turned in the opposite direction, being thus finally restored to their original position. On account of lost motion and backlash, it is necessary to slightly lower the table during the backward movement in order to prevent the rotating cutters from marring the finished grooves. This lowering is effected by means of the handle 11 which serves to lower the knee 3 and all of the parts carried thereby. When the table has been moved to starting position, the handle 11 is returned to the position shown, thus restoring the table to its operative position.

After the milling of one groove it is necessary to index the blanks to position them for the milling of the next groove. In order that indexing may be effected, the gear 52 is connected with the shaft 21 by means of a suitable indexing device. This device comprises an index plate 57 detachably connected with the gear 52 and a lever 58 connected with the shaft 21 and carrying a spring-pressed detent 59 adapted to be seated in any one of a series of holes 60 in the plate 57. As illustrated, the worm 22 and the worm wheels 23 and 23^a are so constructed that the spindles make one revolution for each revolution of the worm and of the shaft 21. The plate 57 is therefore provided with as many holes 60 as there are to be grooves in each blank. If a different number of grooves is desired a different plate is substituted. By withdrawing the detent from one hole and moving it to the next the operator can index all four of the blanks to the same extent and through the required angle.

After indexing the feed is again started and the operations before described are repeated until all of the grooves have been milled.

In Figs. 1 to 5 the machine is shown as adjusted for the cutting of left-hand grooves in the blanks. For the cutting of such grooves the blanks are so positioned with respect to the cutters that the cutters will engage the blanks at one side thereof; that

is, at the right-hand side thereof, as viewed in Fig. 5. This adjustment is effected by moving the saddle 2. Figs. 6 and 7 show, on an enlarged scale, the relationship between one of the blanks and the corresponding cutter. Inasmuch as the cutter axis is perpendicular to the blank axis and inasmuch as the grooves are inclined or helical it is possible for correct cutting to take place only when the cutter has its cutting edges inclined with respect to the cutter axis. The cutting edges as they rotate generate conical surfaces which can have line tangency or contact with helicoidal surfaces such as those of the grooves. If any of the cutting edges of either set were perpendicular to the cutter axis they would generate a plane surface which would intersect the helicoidal surface and which could not have line tangency therewith. It will be clear that the inclined cutting edges of the cutter can conform to the shape of the groove only when the cutter is at one side of the cutter axis as shown in Fig. 7.

When right-hand grooves are to be cut in the blanks, the blank and the cutter have the relationship shown in Figs. 8 and 9. The blank is indicated by A′ and the cutter by 47′. For cutting such right-hand grooves, it is necessary for the blank to be turned in the opposite direction, and this is effected by the arrangement of gearing shown in Fig. 10. It will be noted that this arrangement differs from that shown in Fig. 1 by the inclusion of an intermediate idler gear 61 between the gears 52 and 53. This gear is mounted on a removable stud 62 held in a slot 63 in the frame 15. When the idler gear is used the stud 54 and the gear 53 are moved to new positions. The idler gear reverses the direction of rotation and causes the rotative movement of the blanks to take place in the opposite direction from that shown in Fig. 5.

What I claim is:

1. The combination of a horizontally movable frame, a plurality of blank-holding spindles longitudinally mounted on the frame, a plurality of milling cutters rotatable about a common axis and arranged to engage the respective blanks to cut grooves therein, and means for simultaneously turning the spindles and blanks as they move longitudinally with the frame, the said means comprising a rack fixed against movement with the frame and gearing carried by the frame and including a gear meshing with the rack.

2. The combination of a horizontally movable frame, a plurality of blank-holding spindles longitudinally mounted on the frame, a plurality of milling cutters each having their two sets of cutting edges oppositely inclined with respect to the cutter axis, the said cutters being rotatable about a common axis perpendicular to the spindle axes and being arranged to engage the respective blanks at the sides thereof to cut grooves therein, means for effecting relative adjustment transversely of the spindle axes and longitudinally of the cutter axis whereby the relationship between the cutters and the blanks may be changed from one side to the other, and means whereby the spindles and blanks may be turned in either direction as they move longitudinally with the frame.

3. The combination of a headstock comprising a plurality of parallel rotatable blank-holding spindles, a tailstock comprising a similar plurality of blank-engaging centers alining respectively with the spindles of the headstock, the said centers being spring-pressed and independently movable longitudinally, and means for moving the tailstock as a whole longitudinally.

4. A milling machine attachment comprising a frame adapted to be mounted on the milling machine table, a headstock on the frame having a plurality of parallel horizontal blank-holding spindles, and mechanism comprising gearing on the frame and a rack adapted to be secured to the milling machine saddle for turning all of the spindles simultaneously as the table is moved.

5. A milling machine attachment comprising a frame adapted to be mounted on the milling machine table, a headstock on the frame having a plurality of parallel horizontal blank-holding spindles, a tailstock bodily movable with respect to the frame and having a plurality of centers respectively alining with the spindles, and mechanism comprising gearing on the frame and a rack adapted to be secured to the milling machine saddle for turning all of the spindles simultaneously as the table is moved.

6. A milling machine attachment comprising a frame adapted to be mounted on the milling machine table, a headstock on the frame having a plurality of parallel horizontal blank-holding spindles, mechanism for turning all of the spindles simultaneously as the table is moved, a cutter arbor adapted to be connected with the milling machine spindle, cutters on the arbor spaced to respectively engage blanks held by the spindles, bearings engaging the arbor between the cutters, and means for securing the bearings to the milling machine overarm.

7. The combination of a headstock comprising a plurality of parallel rotatable blank-holding spindles, a chuck mounted in each spindle, a tailstock comprising a similar plurality of blank-engaging centers aligning respectively with the spindles of the headstock, means for moving the tailstock as a whole longitudinally to engage the centers with the blanks and to simultane-

ously force the latter into the chucks, and a single controlling means for closing all the chucks simultaneously.

8. The combination of a headstock comprising a plurality of parallel rotatable blank-holding spindles, a chuck mounted in each spindle, a tailstock comprising a similar plurality of blank-engaging centers aligning respectively with the spindles of the headstock, means for moving the tailstock as a whole longitudinally to engage the centers with the blanks and to simultaneously force the latter into the chucks, the centers being spring-pressed and independently movable longitudinally whereby each engages its blank with an equal pressure, and a single controlling means for closing all the chucks simultaneously.

9. The combination of a headstock comprising a plurality of parallel rotatable blank-holding spindles, a chuck mounted in each spindle, each chuck being provided with a stop adapted to limit the inward movement of a blank, a tailstock comprising a similar plurality of blank-engaging centers aligning respectively with the spindles of the headstock, each center being non-positively mounted in the tailstock whereby a limited longitudinal movement thereof is permitted when engaged against a blank with a predetermined pressure, means for moving the tailstock as a whole longitudinally to engage the centers with the blanks and to simultaneously force the latter into the chucks against the stops, and a single controlling means for closing all the chucks simultaneously.

10. The combination of a headstock comprising a plurality of parallel rotatable blank-holding spindles, a chuck mounted in each spindle, each chuck being provided with a stop adapted to limit the inward movement of a blank, a tailstock comprising a similar plurality of blank-engaging centers aligning respectively with the spindles of the headstock, each center being spring-pressed and independently movable longitudinally, means on each center for limiting its longitudinal inward movement relative to the tailstock, means for moving the tailstock as a whole longitudinally to engage the centers with the blank and to simultaneously force the latter into the chucks against the stops, the center springs being adapted to yield to allow for any inequality in the length of the blanks, and a single controlling means for closing all the chucks simultaneously.

In testimony whereof, I hereto affix my signature.

FRIEDERICH MÜLLER.