No. 612,466. Patented Oct. 18, 1898.

C. C. TYLER & C. L. GROHMANN.

MILLING MACHINE.

(Application filed Nov. 12, 1897.)

(No Model.) 4 Sheets—Sheet 1.

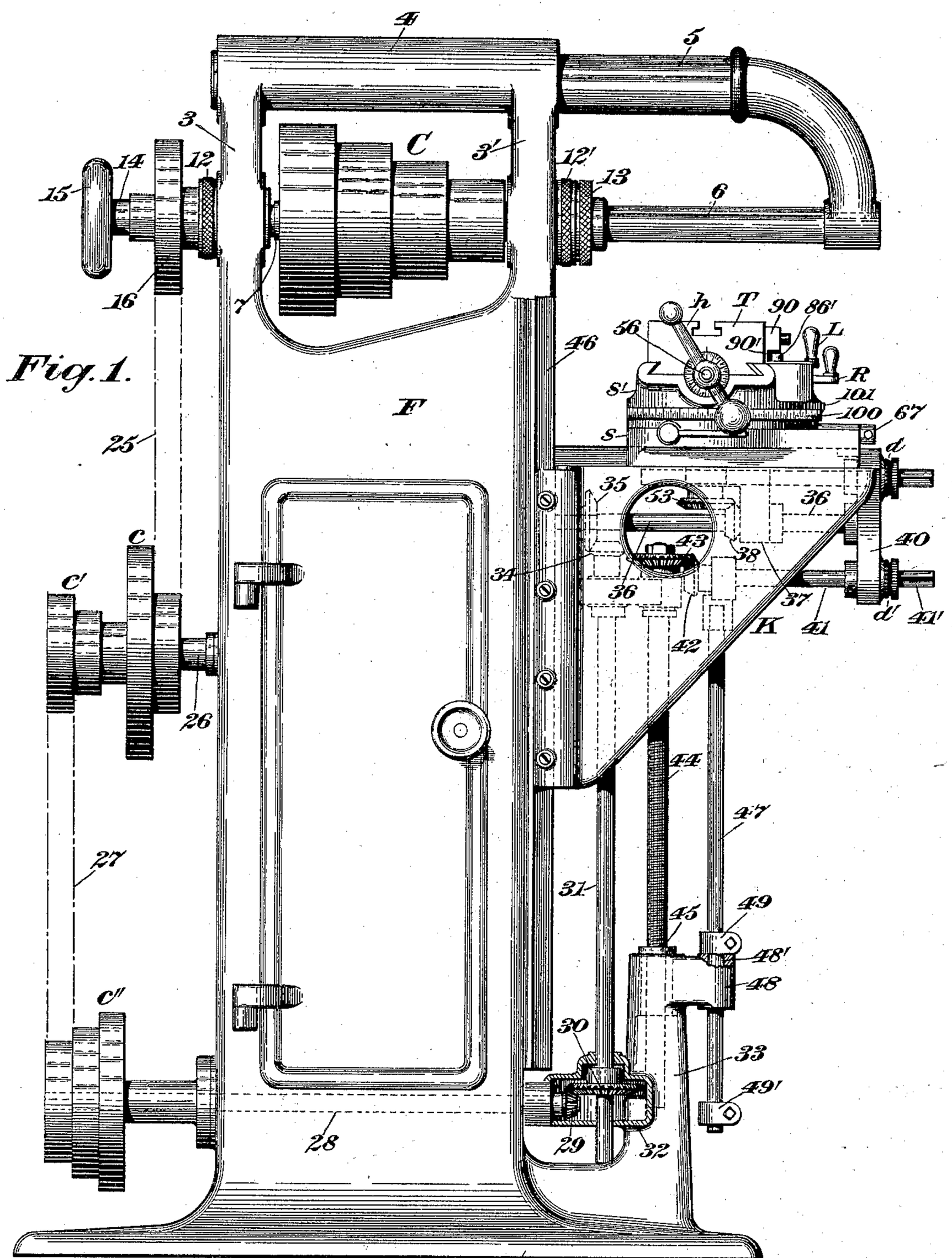

Fig. 1.

Witnesses:
Chas. F. Schmelz
Fred. J. Dole.

Inventors:
Charles C. Tyler,
Carl L. Grohmann.
By their Attorney,
F. A. Richards.

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Fig. 2.

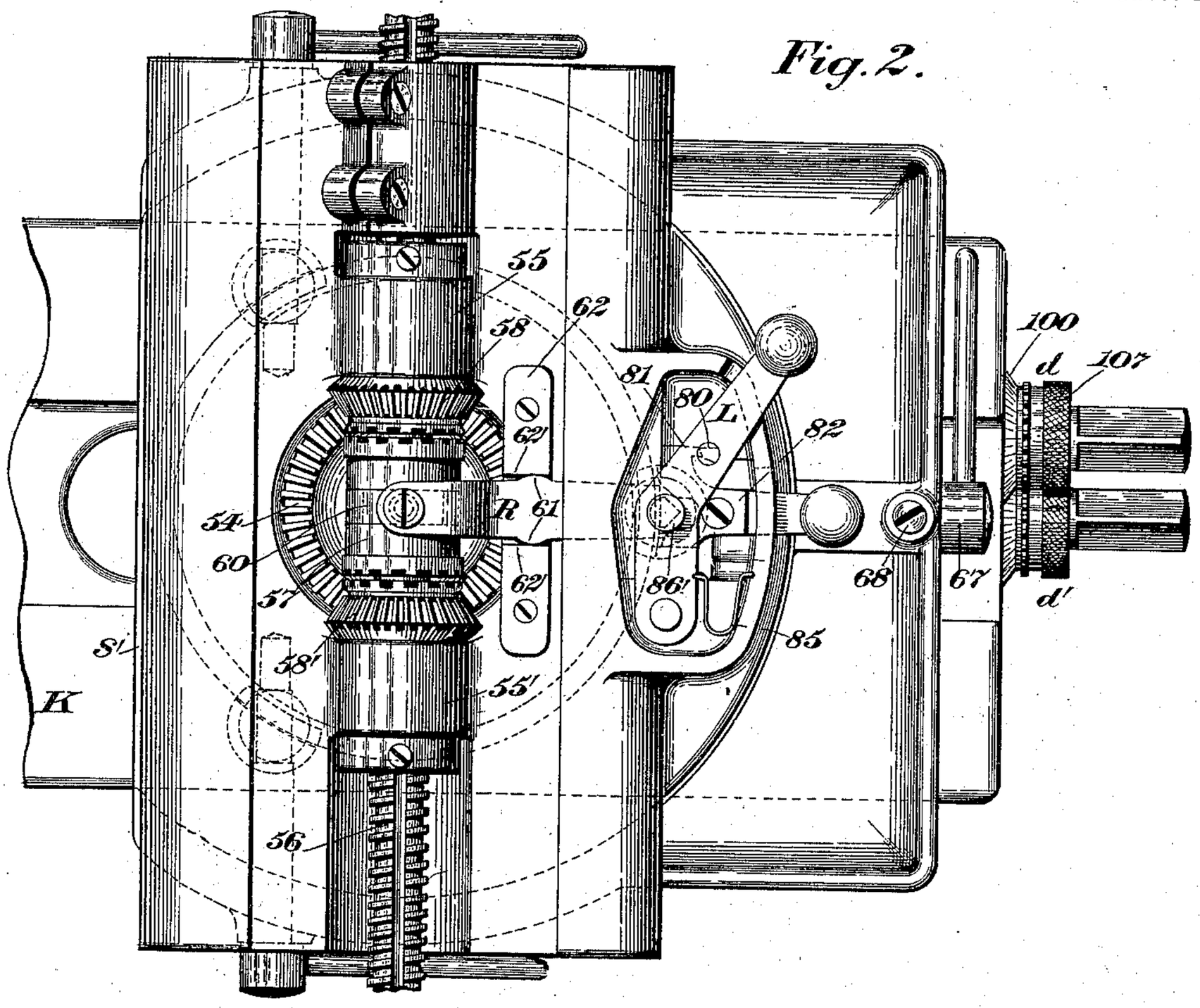


Fig. 3.

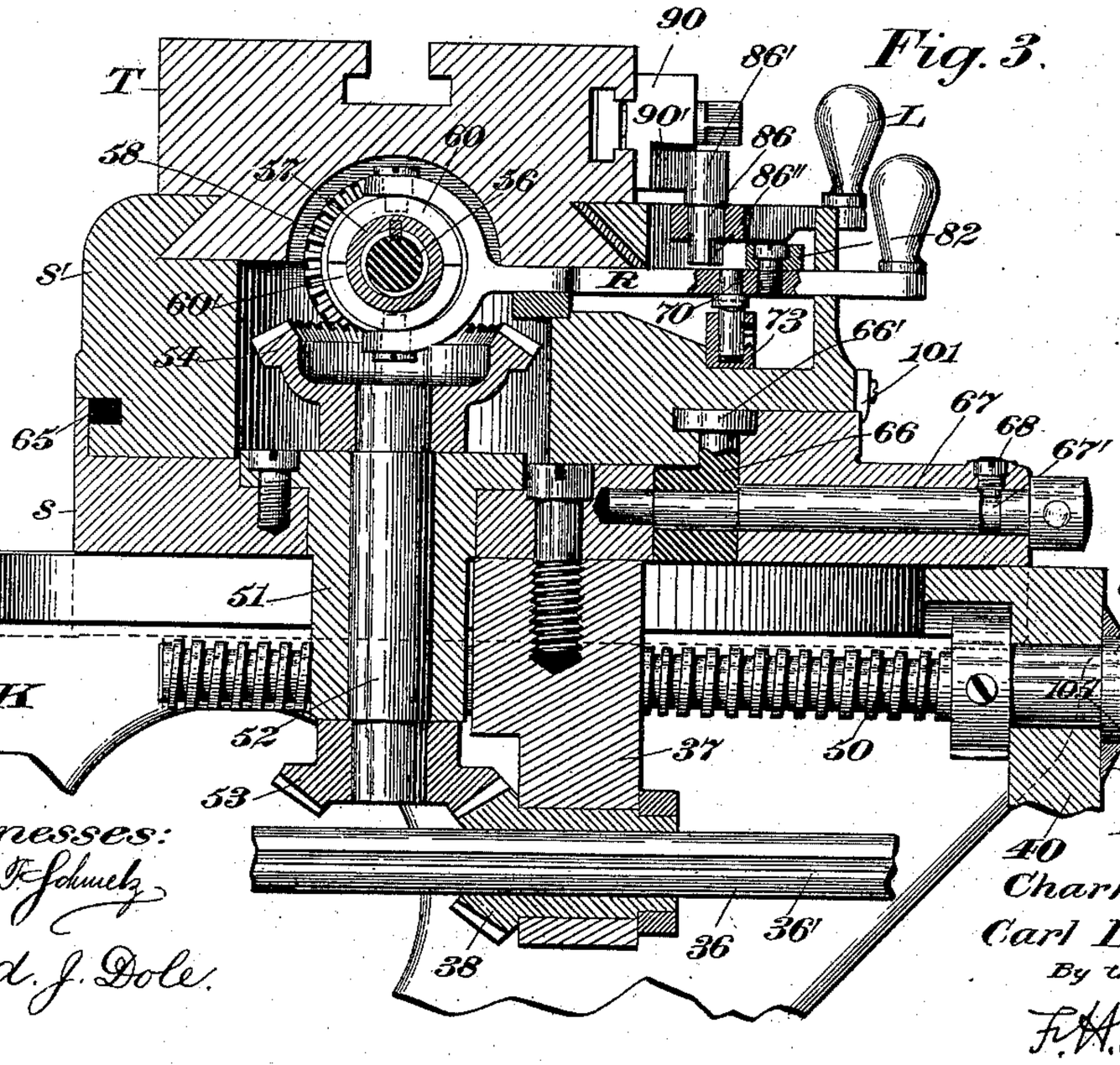
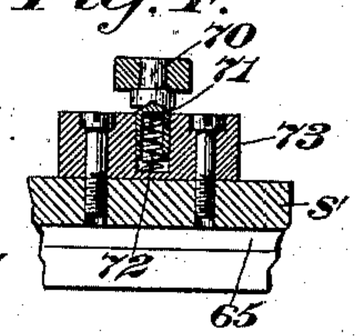


Fig. 4.



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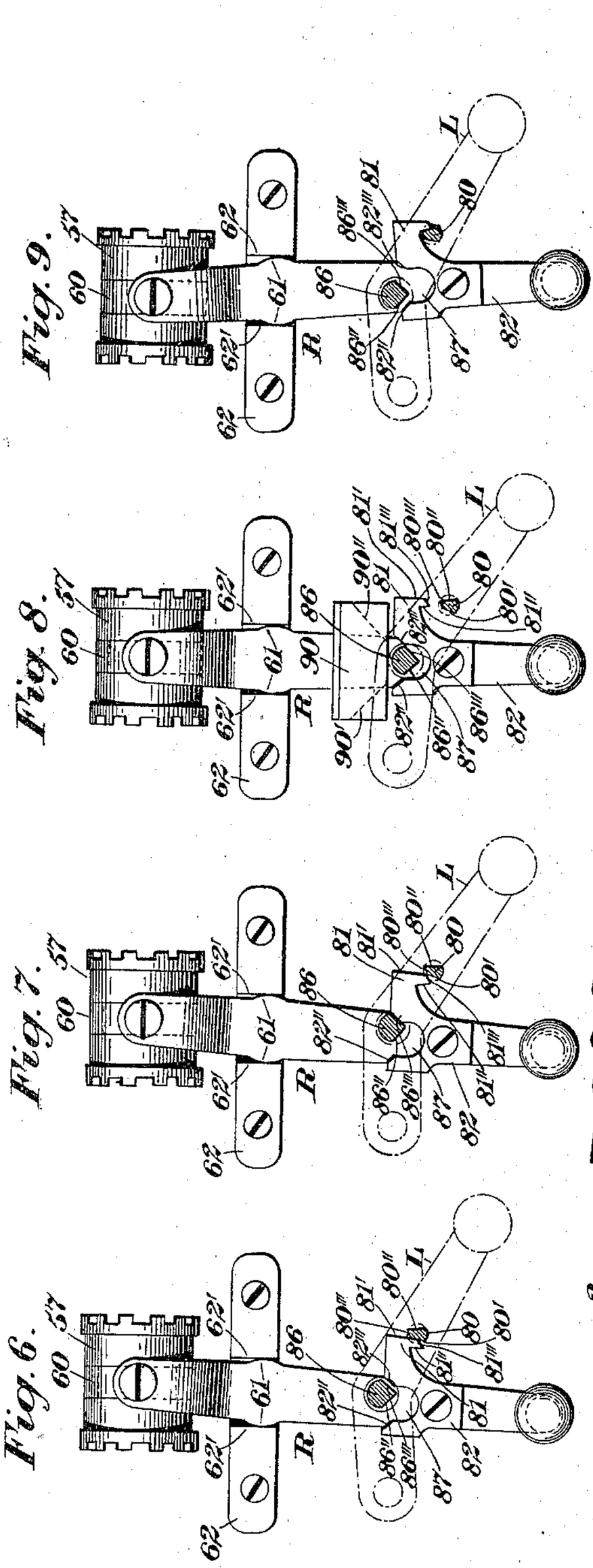
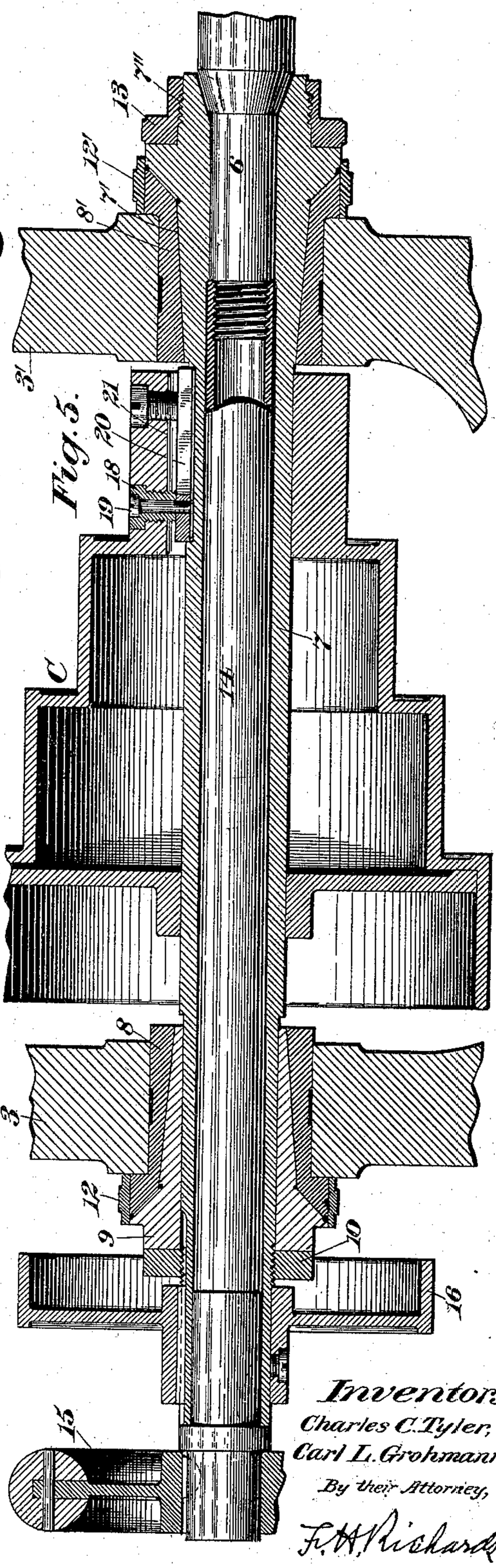
MILLING MACHINE.

(No Model.) (Application filed Nov. 12, 1897.)

4 Sheets—Sheet 3.





Witnesses:
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Fred. J. Dole.

Inventors:
Charles C. Tyler,
Carl L. Grohmann.
By their Attorney,
F. W. Richards.

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MILLING MACHINE.

(Application filed Nov. 12, 1897.)

(No Model.) 4 Sheets—Sheet 4.

Fig. 10.

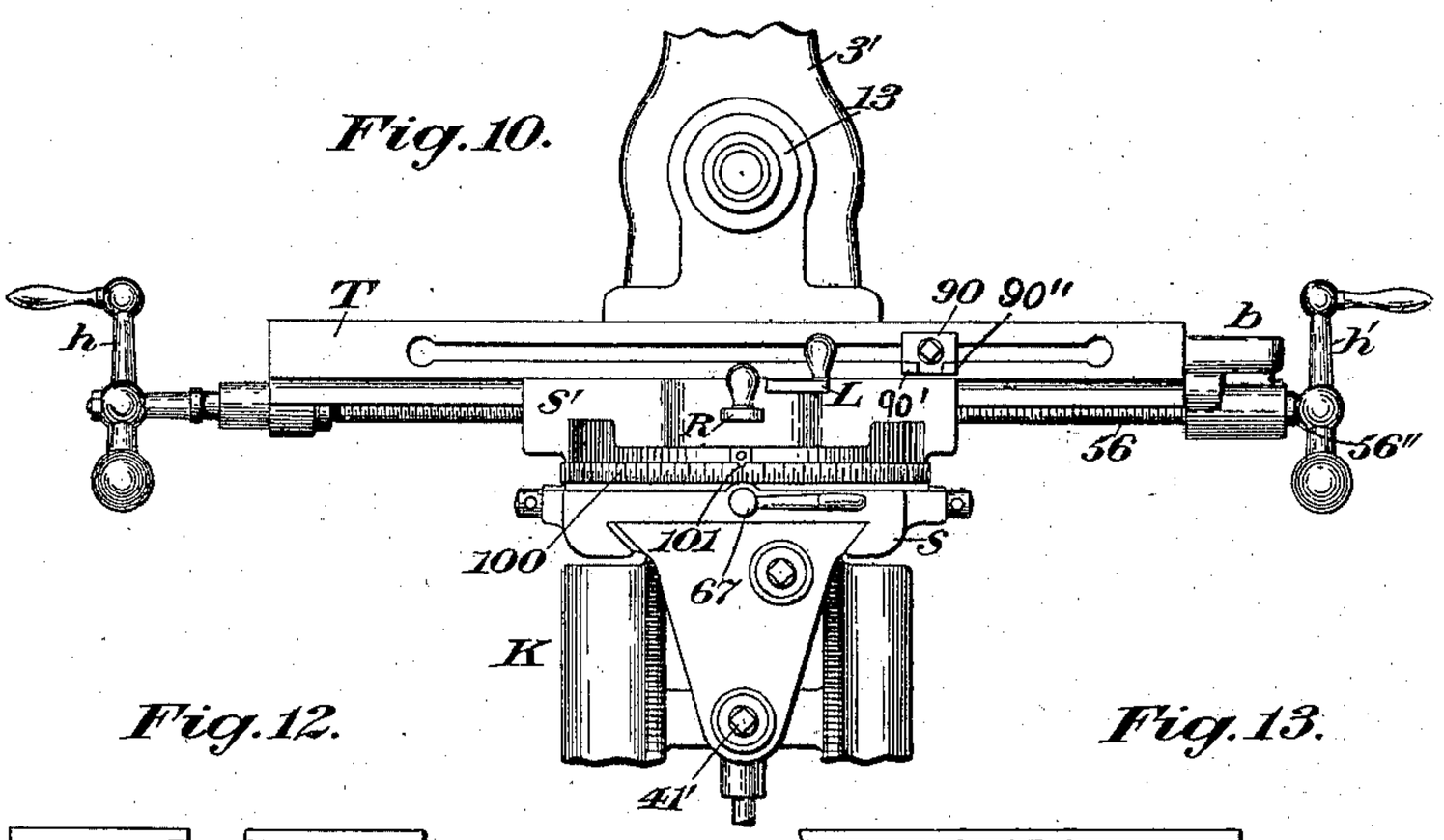

Fig. 12.

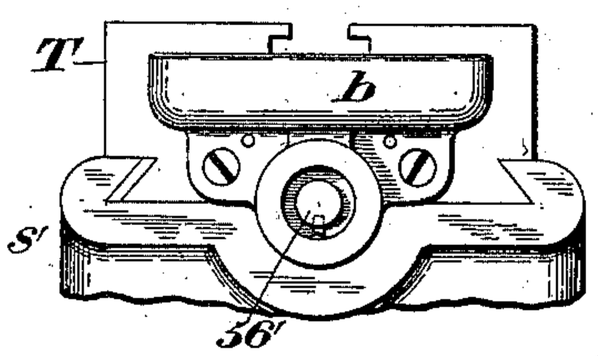

Fig. 13.

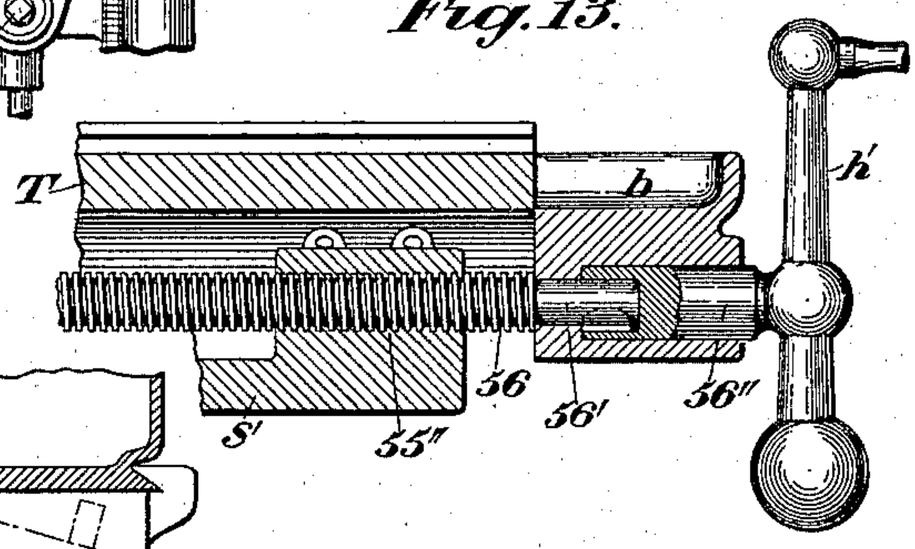

Fig. 11.

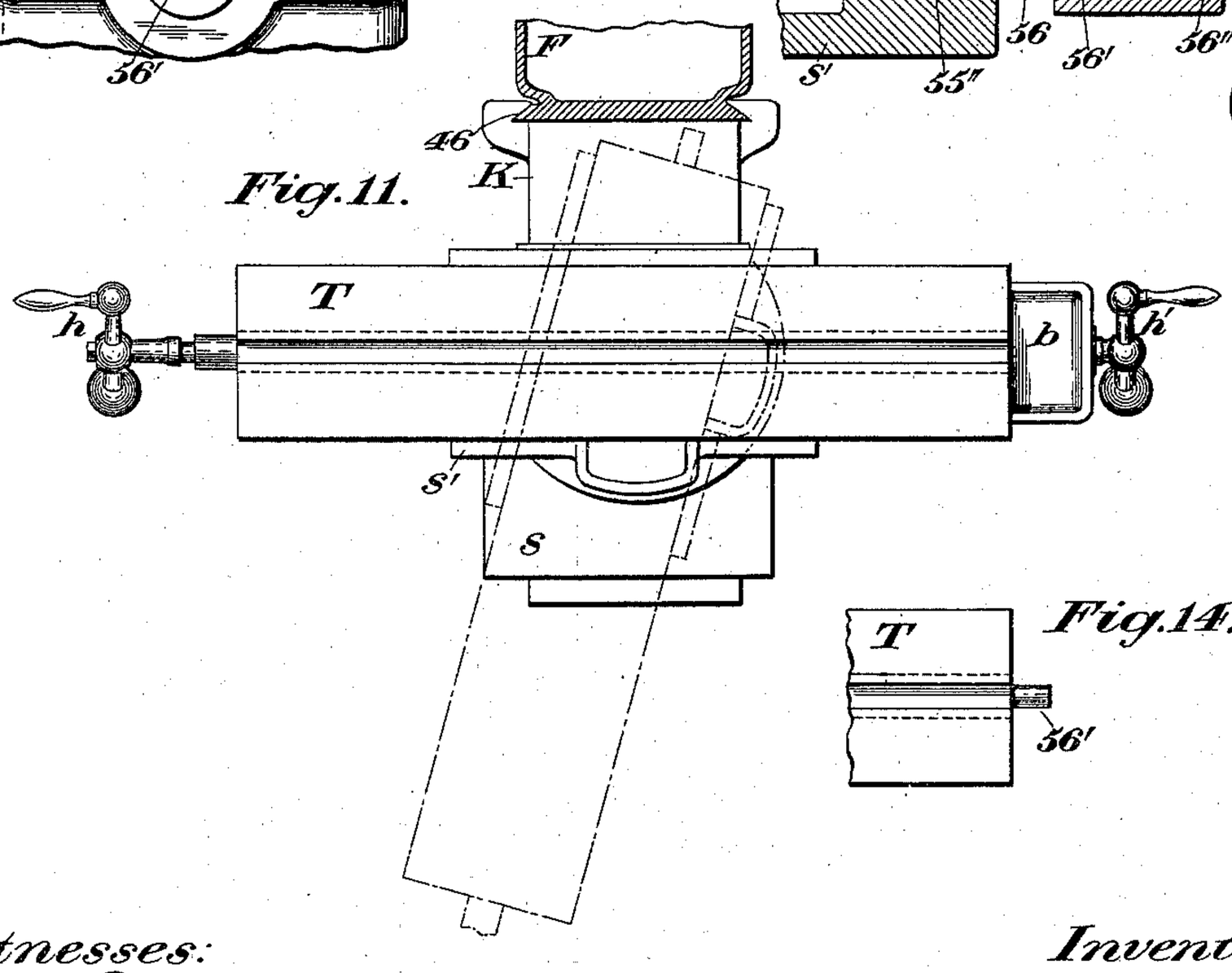

Fig. 14.

Witnesses:

Chas. F. Schmelz

Fred. J. Dole.

Inventors:

Charles C. Tyler,

Carl L. Grohmann.

By their Attorney,

F. A. Richards.

UNITED STATES PATENT OFFICE.

CHARLES C. TYLER AND CARL L. GROHMANN, OF HARTFORD, CONNECTICUT.

MILLING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 612,466, dated October 18, 1898.

Application filed November 12, 1897. Serial No. 658,252. (No model.)

To all whom it may concern:

Be it known that we, CHARLES C. TYLER and CARL L. GROHMANN, citizens of the United States, residing at Hartford, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Milling-Machines, of which the following is a specification.

This invention relates to improvements in milling-machines, and especially to universal milling-machines; and it has for its main object the provision of an improved machine of this class in which the movements of the traveling feed-table or carriage on which the work is mounted can be controlled more perfectly than those in mechanisms of this kind as heretofore constructed. For the purpose of attaining this end we employ, in connection with the usual reversing arm or lever, by means of which the starting, the stopping, and the reversal of the movement of the main feed-screw are controlled, automatic locking means, preferably in the form of a spring-pressed locking arm or lever, so constructed as to engage the reversing arm or lever when the latter is shifted from an idle to a working position and hold such reversing-lever in its working position in such a manner that it will be impossible to return the reversing-lever to its idle position without first operating the locking-lever to release it from engagement with the other lever. As some suitable reversing mechanism for permitting the rotation of the main feed-screw in opposite directions is embodied in all milling-machines of this type as now made, the reversing-lever will of course be shiftable from an idle position to two working positions, one of such working positions being usually at each side of the central idle position of the reversing arm or lever, and hence the locking means which we employ in order to be effective to control the reversing-lever under all circumstances should be of such construction as to engage the reversing-lever when the latter is either in its right or left hand working position.

In order that the return movement of the stopping or reversing lever may be absolutely dependent upon its release by the locking arm or lever, this locking-lever preferably constitutes an actuating member or lever for operating the reversing-lever to shift the latter back to its idle position when it is desired to stop the traveling movement of the main feed-screw, it being understood, of course, that this actuating-lever should operate as such whether the stopping or reversing lever is returned from a single working position or from either one of two working positions to the idle position.

As it is customary in milling-machines as now constructed to stop the movement of the feed-screw automatically, we prefer that the devices thus described be operative for returning the reversing-lever automatically to its idle position when the feed-table shall have traveled a predetermined distance, the extent of which movement may be determined by a stop carried at a suitable point thereon. This stop is intended in the construction shown herein to actuate the locking-lever or actuating-lever which controls the main or reversing lever and to shift such actuating or locking lever to return the reversing-lever to its idle position at the proper time. Obviously, therefore, the actuating member by which the reversing-lever is shifted back to an idle position will preferably be carried independently of and have a movement relatively to the movement of the reversing-lever. In the construction shown in the drawings for controlling this movement of the reversing-lever the actuating member is shifted transversely of and out of the path of movement of the stop on the feed-table, the range of movement of the actuating member being such that when the reversing-lever is shifted back to its idle position such actuating member is clear of the stop on the feed-table and out of the path of movement of such stop, so that the feed-screw may be turned by hand and such stop fed by or past this shiftable actuating member or stop which controls the reversing-lever.

Other features of the invention relate to the manner in which the main feed-screw is driven through connections on the cross-feed slide and the swivel to the fastening means for securing the swivel to the slide, to the in-

dicating or micrometer dials for indicating the extent of movement of the adjusting feed members, to the manner in which the step-cones are secured to the main driving-spindle, and to other details of construction, all of which will be described fully hereinafter.

In the drawings accompanying and forming part of this specification, Figure 1 is a side elevation, partly in section, of a milling-machine embodying this invention. Fig. 2 is an enlarged detail plan of a portion of the machine, illustrating the swivel, the cross-feed slide, the reversing mechanism, and the locking-lever for the reversing-lever, the feed-table or traveling carriage being removed. Fig. 3 is a transverse section of the same with the feed-table in place. Fig. 4 is a sectional detail illustrating the spring-pressed detent for holding the reversing-lever in its central or idle position. Fig. 5 is an enlarged vertical sectional detail illustrating the construction of the main driving mechanism, including the step-cones, the driving-spindle, the drawing-in spindle, the arbor, and the connections between the step-cones and the main driving-spindle. Figs. 6 to 9, inclusive, are details illustrating different positions of the reversing-lever and the locking-lever therefor. Figs. 10 to 14, inclusive, are details of the operating connections between the swivel and feed-table.

Similar characters designate like parts in all the figures of the drawings.

As to many of the features thereof the machine shown in the drawings of this application and described in this specification is similar to milling-machines as at present constructed. The several operative parts are mounted, substantially in the usual manner, upon a main frame or column (designated in a general way by F) rising from a base 2. At the upper end thereof this frame is open and has a pair of side frames 3 and 3′, connected at their upper ends by a long bearing 4, in which may be secured a swinging arm 5, having at the outer end thereof a bearing positioned and adapted to receive and support the free end of the main arbor, which is indicated herein by 6. The main driving-spindle is shown at 7 and is journaled at its opposite ends in suitable bushed bearings in the side frames or uprights 3 and 3′. At the front end thereof this main driving-spindle is tapered, as shown at 7′, and hence the bushing 8′ is correspondingly tapered internally, while at the rear end thereof said spindle has splined thereon a tapered sleeve 9, journaled in a correspondingly-tapered bushing 8. The spindle 7 is screw-threaded near its rear end to receive an adjusting-nut 10, by means of which wear on the parts may be taken up from time to time. (See Fig. 5.)

For the purpose of excluding dust from the two bearings of the main spindle we have shown at 12 and 12′ collars encircling the bushings and the adjacent portions of the spindle and its adjusting-collar. At its front end the spindle 7 is also screw-threaded, as shown at 7″, to receive a face-plate or similar part and a milled collar-nut or cap, such as 13, will ordinarily cover such threaded end.

In connection with the driving-spindle 7 we may employ a drawing-in spindle, such as 14, which will preferably be tubular and have internal threads at its forward end, so that it may engage the correspondingly-threaded end of the main arbor or other part, such as 6, which is to be rotated by the spindle 7. This main arbor will preferably be tapered and will enter a tapered opening at the forward end of the spindle 7, the arbor and the spindle being suitably keyed together, as shown, for example, in Fig. 5. At the other end thereof the drawing-in spindle 14 has keyed thereto a hand-wheel, such as 15, while the driving-spindle 7 carries a driving-pulley 16 for transmitting the movement of the main spindle to the several working parts below the same.

In Fig. 5 we have illustrated an improved construction for connecting the step-cones (designated in a general way by C) to the driving-spindle 7. The essential feature of this connection is a duplex fastening device, the main member of which is in the form of a tubular screw 18, screwed to one of the rotary members, preferably to the step-cone, and adjustable therein, while the other member of the fastening device is carried by the main member or screw 18 and may be in the form of a screw-bolt 19, journaled in the screw 18 and threaded into a spline 20, carried in a key-seat 21 of greater depth than the spline. Two of these fastening devices are illustrated herein, and it will be seen that the outer screws 18 may be adjusted to lock the spline in any desired position in its seat, while the screw-bolts 19 will hold the spline firmly in place when it is adjusted properly. By means of these fastening devices the spline will be so held as to prevent cramping, and the retention of the spline in its proper position will be assured.

The connections between the main driving-spindle and the feed-table on which the work is carried are clearly shown in Fig. 1. From the driving-pulley 16 a belt 25 passes in this case to one of a pair of step-cones c on a shaft 26, carrying a second set of cones c', any one of which may drive a belt 27, which passes around one of another set of cones c'' on a driving-shaft 28, passing through the frame of the machine to the front thereof and journaled therein near the base 2. At the forward end thereof the shaft 28 carries a bevel-pinion 29, which meshes with a bevel-gear 30, splined on a vertical shaft 31, so as to slide freely thereon. This shaft 31 is journaled at its lower end in a housing 32, connecting the main frame F and a hollow post 33, rising from the base 2, and at its upper end in a suitable bearing on the vertically-adjustable carrier or knee of the machine, which carrier or knee is designated in a general way by K.

At its upper end the shaft 31 carries a bevel-pinion 34, which is held against vertical movement relatively to the knee by suitable stop-shoulders, said pinion meshing with a spur-gear 35, secured to a horizontal shaft 36, mounted in bearings on the knee K. One of the bearings for this shaft is carried by the usual cross-feed slide, which is designated herein in a general way by *s*, and is mounted in the usual manner on the knee, so as to travel thereon in a line parallel with the longitudinal axis of the horizontal shaft 36. The movable bearing for said shaft is in the present case formed in a block or hanger 37, depending from the cross-feed slide, and in this bearing a bevel-gear 38, having a long hub, is journaled, as shown in Fig. 3, so as to travel with the cross-feed slide, while rotatable in said hanger.

It will be understood, of course, that the bevel gear or pinion 38 should slide on the shaft 36, and hence the latter has extending therealong a key-seat 36′, so as to assure the rotation of the shaft 36 regardless of the movement of said bevel-pinion along said shaft. The forward end of the horizontal shaft 36 is journaled in a bracket or hanger 40, depending from the forward end of the knee, and at the lower end of this bracket the forward end of a rotary feed member 41 is journaled, the rear end of said feed member or shaft being mounted in any suitable bearing on the body portion of the knee. At its rear end the shaft 41 carries a bevel-pinion 42, which meshes with a bevel-gear 43 on the upper end of the usual elevating feed-screw 44, the lower end of which passes through a threaded nut 45, fixed in the upper end of the tubular post 33. It will be obvious that by means of a crank applied to the forward squared end 41′ of the shaft 41 the elevating-screw may be turned and the knee raised or lowered to adjust it to any desired height, this knee of course sliding in the usual manner on a way 46 on the forward side of the main frame or column F.

In connection with the parts just described we have also shown the usual gage-rod 47, passing through a bore 48′ in a bracket 48, projecting laterally from the post 33, this gage-rod having the usual adjustable stops 49 and 49′.

As before stated, the cross-feed slide is slidable in the usual manner on the knee K, and for the purpose of locking said slide with precision we have shown herein at 50 the usual cross-feed-slide adjusting-screw, by means of which a micrometric adjustment may be obtained. This slide also has a vertical journal-bearing 51, the vertical axis of which intersects the longitudinal axis of the horizontal shaft 36. This vertical bearing is adapted to receive a vertical shaft 52, the extreme ends of which are reduced slightly to form stop-shoulders in alinement with the ends of the bearing 51, and on these reduced portions are secured a pair of bevel-gears, the lower of which 53 meshes with the bevel-pinion 38 and is driven thereby, while the upper gear 54 is adapted to operate the feed-screw carried by the swivel. The swivel which we employ in this case is mounted substantially in the usual manner for rotation on the cross-feed slide and has its axis of rotation coincident with the axis of the vertical shaft 52. This swivel is designated in a general way by *s′* and has a pair of bearings 55 and 55′, in which the main feed-screw controlling the movements of the feed-table (indicated herein at T) is supported for rotation. The connection between this feed-screw and the table may be obtained by passing the feed-screw through a fixed lug 55″ on the swivel.

The feed-screw is designated herein by 56 and has a long groove or seat for a spline, by means of which a clutch member, such as 57, is secured to the feed-screw for rotation therewith while sliding freely therealong. This construction is illustrated clearly in Figs. 2 and 3.

In Figs. 10 to 14, inclusive, we have illustrated in detail the manner in which the connection between the swivel and the feed-table is effected. This feed-table has at one end thereof a detachable bearing, (designated by *b*,) and this may be detachably secured to the main part of the feed-table by means of screws. This detachable bearing has a journal-opening for the reception of the smooth journal portion 56′ of the feed-screw, and it will be clear that by turning the handle *h* the feed-screw may be withdrawn readily from said bearing.

The connection between the smooth end 56′ of the feed-screw and the other operating-handle or ball-lever may be obtained in the manner indicated in detail in Fig. 13, in which the feed-screw has a supplementary portion 56″, to which the part 56′ is keyed, the ball-lever *h′* being secured to the extreme outer end of the part 56″. By connecting the feed-screw with the feed-table, at one end thereof, in the manner just described we provide a work holder or table having a very much wider range of usefulness than devices of this type heretofore used.

It frequently happens that it is desirable to turn the feed-table to such an extent that the latter, if constructed in the ordinary manner, would strike against and would be stopped by the main upright or some other part of the framework; but by providing the detachable bearing *b* it will be evident that the latter may be unscrewed from the end of the main portion of the feed-table and the handle *h′* withdrawn from the feed-screw, whereupon the feed-table may be swung to the position shown in Fig. 11, and hence move substantially if not quite in a complete circle. This construction also permits of the withdrawal of the feed-screw from the detachable bearing *h* without removing the latter from the table proper, as will be evident.

The clutch member 57 forms one element

of a reversing driving mechanism by means of which the feed-screw may be rotated in either direction from the bevel-gear 54. The usual bevel-gears 58 and 58′, in mesh with the gear 54, are employed for the purpose of rotating this feed-screw in the one direction or the other, these bevel-gears being journaled in the bearings 55 and 55′ and having longitudinal bores or journal-openings in alinement with the corresponding bore in the clutch member 57, through which openings the feed-screw passes.

The clutch member 57 is peripherally grooved, as shown in Figs. 2 and 3, and in this groove is seated a bifurcated collar, the two members 60 and 60′ of which are connected with the opposite ends of the forked portion of the usual reversing arm or lever, which is indicated herein at R, this collar being divided in this manner in order to permit the parts to work freely, while maintaining a tight joint. The reversing-lever may be pivoted on the swivel in any suitable manner, it having preferably opposite rounded bosses 61 projecting from the sides thereof and held between parallel side walls 62′, preferably formed in a detachable block 62, secured to the swivel.

For the purpose of clamping the swivel in any desired adjusted position we prefer to employ the devices shown in detail in Figs. 2 and 3. In the construction shown therein the swivel has a peripheral groove 65 near the under side thereof, and the cross-feed slide *s* has a circuit of vertical seats for the reception of studs 66, by means of which the swivel may be clamped to the slide. Each of these studs preferably has a mutilated head 66′, adapted to engage the lower wall of the peripheral groove 65, so as to draw the swivel down toward the slide *s*. Each stud is also bored horizontally in alinement with corresponding bores in the slide for the purpose of receiving a cam-bolt, (designated herein by 67,) by means of which cam-bolt the stud will be wedged in place to clamp the swivel and the slide together. Each of these cam-bolts may be secured against longitudinal movement by suitable holding means, such as a set-screw 68, working in a peripheral groove 67′ in the bolt.

It will be noticed by referring to Fig. 2 that one of these cam-bolts is at the front of the cross-feed slide and extends longitudinally thereof, while the other two are in alinement with each other and extend crosswise of said axis of the slide, the three cam-bolts preferably being so disposed as to locate the swivel at three substantially equidistant points.

The lever R is a combined stopping and reversing lever and in controlling one of the movements of the feed-screw moves from an idle to a working position, and vice versa, to shift the clutch member 57 into position to start the rotation of the feed-screw or to stop the latter. As the feed-screw is intended to rotate in both directions, the reversing-lever should of course be shiftable from a central idle position to a working position at either side of such idle position in order that the clutch member may be thrown into engagement with one or the other of the bevel-gears 58 and 58′ or disengaged from both of such gears. When in its normal idle central position, the reversing-lever may be held by suitable yielding holding means—such, for example, as a spring-pressed detent. A device suitable for this purpose is illustrated in detail in Fig. 4, in which 70 designates a pin having a substantially V-shaped nick in its head, and 71 indicates a spring-pressed pin having a V-shaped point adapted to take into the correspondingly-shaped nick in the pin 70 when the reversing-lever is in its central position. The pin 71 is preferably hollow and normally held by a light spring 72, this spring-pressed pin or detent being mounted in this case on a block 73, suitably secured to the swivel *s*′.

In the operation of milling-machines as heretofore constructed it has been customary, so far as we are aware, to shift the reversing-lever directly from its idle to its working position and to return it in the same manner, no provision being made in such machines for locking the reversing-lever in a working position to prevent the premature accidental return of the same to an idle position. Moreover, in all of these machines the movement of the feed-table has been positively limited by some suitable stopping mechanism, so that the feed-table could not be fed past the stop. In the present case, however, the provision of suitable means for locking the reversing arm or lever in its working position until the feed-table reaches the end of a predetermined range of movement and of means for enabling the feed-table to be fed past the stop for limiting the movement thereof constitute the leading features of our present improvements.

While we consider within the scope of our invention any suitable means for locking the reversing-lever in a working position until such locking means is released, we have illustrated herein for this purpose a locking-arm in the form of a lever (designated in a general way by L) and disposed substantially transversely to the reversing or stopping lever R.

The locking-lever L is intended to hold the reversing-lever locked in either of its working positions at opposite sides of the central or idle position of the reversing-lever, and this locking-lever has thereon a fixed stop member 80, positioned to coöperate with a fixed stop 81 on a stop-arm 82, projecting from the reversing-lever. In the construction shown the locking-lever is located above the reversing-lever, and the locking-arm 82 of the reversing-lever is a separate member secured to the reversing-lever and disposed between it and the locking-lever. Each of the stop members 80 and 81 has three stop-faces, the stop-face 80′ on the locking-lever

coöperating with the stop-face 81′ on the reversing-lever to hold the latter locked in its left-hand position, (shown in Fig. 6,) and the stop-face 80″ coöperating with the stop-face 81″ to lock the reversing-lever in its right-hand position, as shown in Fig. 9, while the stop-face 81‴ of the reversing-lever engages the stop-face 80‴ of the locking-lever when the former is in its normal central position to limit the movement of the locking-lever and prevent the locking of the reversing-lever. The locking-lever will preferably be spring-pressed, as shown at 85, Fig. 2, so that when the reversing-lever is shifted either to the right or to the left and the stop-face 80‴ released from the holding-face 81‴ the locking-lever will be automatically actuated by the spring to carry one of its locking-faces 80′ or 80″ into position to lock the reversing-lever in the corresponding working position thereof. It will be noticed that the stop-faces 80‴ and 81‴ are disposed obliquely in order that they may coact properly when the two levers move about their pivots. The locking means for the reversing-lever is also intended to operate as a means for actuating the reversing-lever to return the latter to its normal idle position, and in the present case the locking arm or lever L constitutes reversing-lever-actuating means, which may be operated either manually by the shifting of the locking-lever in the opposite direction to that in which it is moved to lock the reversing-lever or automatically in a similar manner by a stop on the feed-table.

The actuating member proper is indicated herein at 86 and is in the form of a pin fixed on the locking-lever and movable therewith. The upper end of this pin, which is designated by 86′, is intended to be operated by the stop on the feed-table, while the lower end is intended to coact with a suitable face or faces on the reversing-lever. Either one of the levers may have a suitable cam face or faces adapted to coöperate with the other lever to cause the return of the reversing-lever from a working to its idle position; but in the present case the lower end of the actuating member or pin 86 has a pair of independently-effective cam-faces (designated herein by 86″ and 86‴) coöperative, respectively, with a pair of corresponding cam-faces 82″ and 82‴ on the locking member 82 of the reversing-lever. The cam-faces 82″ and 82‴ are disposed at a suitable distance from each other corresponding to the range of movement of the reversing-lever in moving from one working position to the other, and those two faces 82″ and 82‴ are suitably separated—as, for instance, by a recess 87 in the locking-arm 82. The several cam-faces just described are so disposed relatively to each other that when it is desired to unlock the reversing-lever and return it to its idle position the coöperative cam-faces of the two levers will coact to shift the reversing-lever. For example, in Fig. 6 the reversing-lever is shown locked in its left-hand position. In Fig. 7 the reversing-lever is unlocked, owing to the partial shifting of the locking-lever, and the cam-face 86‴ is in contact with the cam-face 82‴ of the reversing-lever ready to shift the latter back to its central position when the locking-lever is returned to its normal position. (Shown in Fig. 2.) It will be noticed also that the locking member 80 and the actuating member 86 are so disposed relatively to each other and to the stop-face 81‴ and the cam-face 82‴ of the reversing-lever that as soon as the reversing-lever is shifted to a working position it will be controlled by the locking-lever, while when it is returned to its central position it limits the movement of such locking-lever. It will be evident, therefore, that while the reversing-lever may be shifted at any time to either of its working positions from an idle position yet it cannot be returned from either working position to its idle position without first operating the locking-lever. Moreover this locking-lever when so shifted constitutes an actuating-lever by means of which the reversing-lever will be returned to its idle position without manipulating the reversing-lever directly by hand.

In order that the action just described—viz., the return of the reversing-lever to its idle position—may be effected automatically and the rotation of the feed-screw stopped, the feed-table should carry therewith in its movement a suitable stop or stops—such, for instance, as illustrated at 90. (See Fig. 3.) This stop is preferably removably secured to the feed-table by a T-and-slot connection in such a manner that the stop or stops will be adjustable to any desired point along the feed-table. The stop 90 preferably has beveled or cam faces 90′ and 90″, adapted to cooperate with the rounded head 86′ of the pin 86 on the locking-lever. As will be obvious, the actuating member or pin 86 constitutes a stop member movable relatively to the stopping or reversing lever, and this stop member or actuating member is intended to be shifted by the stop 90 transversely of the path of movement of such last-mentioned stop and out of such path of movement, as will be evident by reference to Fig. 8. Hence the member 86 is a stopping-arm-actuating or reversing-arm-actuating stop member carried independently of the stop-arm of the reversing-lever R and is operative for returning such reversing-lever to its idle position. As this stop member 86 is shiftable out of the path of movement of the stop 90, it will be seen also that the feed-screw 56 may be turned by hand, if desired, and the stop 90 fed by or past the stop 86 without loosening or removing either of such stops, thus rendering it possible to employ a plurality of stops on the feed-table similar to that shown at 90, each of which in turn may be fed past the stop 86.

For the purpose of properly adjusting the

work (not shown) carried by the feed-table relatively to the tool (not shown) supported by the arbor 6 suitable indicating devices are employed.

In order to control the position of the swivel, the cross-feed slide has thereon a scale 100 concentric with the axis of rotation of the swivel, and the swivel carries a pointer 101. (See Figs. 1 and 3.) The adjusting-screw 50 and the adjusting-shaft 41 also have indicating devices, the former to determine the extent of the cross-feed movement of the slide *s* and the latter to regulate the vertical adjustment of the knee K. These two indicating devices are designated, respectively, by *d* and *d'*, and as they are substantially similar in construction a description of one will suffice for both.

Referring particularly to Fig. 3, 105 designates a micrometer-dial having an internal flange or shoulder 105', adapted to abut against a stop-shoulder 50' on the outer end of the adjusting feed-screw 50, and 106 designates a washer splined on the feed-screw, so as to rotate therewith while movable longitudinally of said screw. Near its forward end this feed-screw is externally threaded, as at 50'', to receive an internally-threaded collar 107, by means of which the dial is secured in position. When the collar 107, which is not in contact with the dial, is screwed tight, it will force the washer 106 against the face of the dial and bind the latter against the stop-shoulder 50', it being obvious, of course, that the rear side of the dial clears the forward face of the bracket 40, so that it wil lnot be in frictional engagement therewith, but will turn with the adjusting feed-screw. When it is desired to obtain a fine adjustment of the cross-feed slide or of the knee, the collar of the proper micrometer-dial should be loosened and the dial proper turned to the zero position, after which the collar or cap should be screwed tight and the adjusting feed member turned the desired distance.

Having described our invention, we claim—

1. The combination, with reversing driving mechanism, of a reversing-arm movable from an idle position to either one of two working positions, and automatic positive locking means unreleasable by movement of the reversing-arm, and operative for locking the reversing-arm in either one of its working positions.

2. The combination, with reversing driving mechanism, of a reversing-arm movable from an idle to a working position and having a stop-face, and an automatic positive locking-arm unreleasable by movement of the reversing-arm, and having a stop-face in position to engage the stop-face of the reversing-arm and lock such reversing-arm when the latter is shifted from its idle to its working position.

3. The combination, with reversing driving mechanism, of a reversing-arm movable from a central idle position to a working position at either side of such idle position and having a pair of stop-faces, and an automatic positive locking-arm unreleasable by movement of the reversing-arm, and having a pair of stop-faces in position respectively to engage the respective stop-faces of the reversing-arm and lock such reversing-arm in either of its working positions.

4. The combination, with reversing driving mechanism, of a reversing-lever movable from an idle to a working position, and a spring-pressed positive locking-lever unreleasable by movement of the reversing-lever, and operative for automatically locking the reversing-lever when the latter is shifted from its idle to its working position.

5. The combination, with reversing driving mechanism, of a reversing-lever movable from an idle to a working position, and an automatic locking-lever unreleasable by movement of the reversing-lever, and movable in one direction for locking the reversing-lever when the latter is shifted from its idle to its working position, and movable in the opposite direction to release said reversing-lever.

6. The combination, with reversing driving mechanism, of a reversing-lever movable from an idle to a working position, and reversing-lever-actuating locking means for locking the reversing-lever when the latter is shifted from its idle to its working position, and for returning the reversing-lever to its idle position.

7. The combination, with reversing driving mechanism, of a reversing-lever movable from an idle position to a working position at either side of such idle position, and reversing-lever-actuating locking means for locking the reversing-lever when the latter is shifted to either of its working positions, and for returning the reversing-lever from either of said working positions to its idle position.

8. The combination, with reversing driving mechanism, of a reversing-lever movable from an idle to a working position; a spring-pressed detent for normally maintaining the reversing-lever in its idle position; and automatic locking means for locking the reversing-lever when the latter is shifted from its idle to its working position.

9. The combination, with reversing driving mechanism, of a reversing-arm movable from an idle to a working position, and an automatic locking-arm for locking the reversing-arm when the latter is shifted from its idle to its working position, and for returning the reversing-arm to its idle position, one of said arms having a cam-face coöperative with the other arm to effect such return movement of the reversing-arm.

10. The combination, with reversing driving mechanism, of a reversing-arm movable from an idle to a working position, and an automatic locking-arm having a locking member for locking the reversing-arm when the latter is shifted from its idle to its working

position, and also having an actuating member for returning the reversing-arm to its idle position.

11. The combination, with reversing driving mechanism, of a reversing-lever movable from an idle to a working position, and an automatic locking-arm having a locking-stop for locking the reversing-lever when the latter is shifted from its idle to its working position, and also having an actuating-cam for returning the reversing-lever to its idle position.

12. The combination, with reversing driving mechanism, of a reversing-arm movable from an idle to a working position, and locking and actuating means for automatically locking the reversing-arm in its working position, and for preventing unlocking of the reversing-arm by direct manipulation of the latter, and for returning the reversing-arm from its working to its idle position.

13. The combination, with reversing driving mechanism, of a reversing-arm movable from a central idle position to a working position at either side of such idle position, and locking and actuating means for automatically locking the reversing-arm in either of its working positions, and for preventing unlocking of the reversing-arm by direct manipulation of the latter, and for returning the reversing-arm from either of said working positions to its idle position.

14. The combination, with reversing driving mechanism, of a reversing-arm movable from an idle to a working position, and a combined locking and actuating arm for automatically locking the reversing-arm in its working position, and for returning the reversing-arm from its working to its idle position.

15. The combination, with reversing driving mechanism, of a reversing-lever movable from an idle to a working position, and an actuating-lever having a fixed member for returning the reversing-lever to its idle position.

16. The combination, with reversing driving mechanism, of a reversing-lever movable from a central, idle position to a working position at either side of such idle position, and an actuating-lever therefor for returning the reversing-lever from either working position to its idle position, one of said levers having a pair of independently-effective cam-faces, and the other a pair of faces coöperative, respectively, with said respective cam-faces to shift the reversing-lever from a working to an idle position.

17. The combination, with reversing driving mechanism, of a reversing-lever movable from an idle to a working position, and an actuating-lever for returning said reversing-lever to its idle position, said levers having coacting cam-faces.

18. The combination, with reversing driving mechanism, of a reversing-lever movable from a central, idle position to a working position at either side of such idle position, and an actuating-lever for returning said reversing-lever to its idle position, said levers having two pairs of coacting cam-faces.

19. The combination, with reversing driving mechanism, of a reversing-lever movable from an idle to a working position and having a pair of stop-faces, and an automatic locking-lever having a pair of stop-faces one of which is normally engaged by one stop-face on the reversing-lever to limit the movement of the locking-lever, and the other of which engages the other stop-face on the reversing-lever and holds the latter when said reversing-lever is shifted from its idle to its working position.

20. The combination, with a traveling feed-table, of driving mechanism therefor; a stop carried by said feed-table; a stopping-arm movable from an idle to a working position; and an automatically-operated stopping-arm-actuating stop member carried independently of said stopping-arm and controlled by the stop on the feed-table and operative for returning the reversing-arm to its idle position.

21. The combination, with a traveling feed-table, of reversing driving mechanism therefor; a stop carried by said feed-table; a reversing-arm movable from an idle position to a working position at either side of such idle position; and an automatically-operated reversing-arm-actuating member carried independently of said reversing-arm and controlled by said stop and operative for returning the reversing-arm to its idle position.

22. The combination, with a traveling feed-table, of driving mechanism therefor; a stop carried by said feed-table; a stopping-lever movable from an idle to a working position; and an automatically-operated stopping-lever-actuating stop member movable relatively to the stopping-lever and controlled by the stop on the feed-table and operative for returning the stopping-lever to its idle position.

23. The combination, with a traveling feed-table, of driving mechanism therefor; a stop carried by said feed-table; a stopping-lever movable from an idle to a working position; and an automatically-operated stopping-lever-actuating stop member movable relatively to the stopping-lever and shiftable by the stop on the feed-table transversely of the path of movement of such stop.

24. The combination, with a traveling feed-table, of driving mechanism therefor; a stop carried by said feed-table; a stopping-lever movable from an idle to a working position; and an automatically-operated stopping-lever-actuating stop member movable relatively to the stopping-lever and shiftable, by the stop on the feed-table, out of the path of movement of such stop.

25. The combination, with a traveling feed-table, of driving mechanism therefor; a stop

carried by said feed-table; a stopping-lever movable from an idle to a working position; and an automatically-operated stopping-lever-actuating stop member movable relatively to the stopping-lever and shiftable, by the stop on the feed-table, transversely of the path of movement of said stop, and operative simultaneously for returning the stopping-lever to its idle position.

26. The combination, with a traveling feed-table, of driving mechanism therefor; a stop carried by said feed-table and having a cam-face; a stopping-lever movable from an idle to a working position; and an automatically-operated stopping-lever-actuating stop member movable relatively to the stopping-lever and shiftable, by the cam-face on the stop on the feed-table, out of the path of movement of such stop.

27. The combination, with a traveling feed-table, of driving mechanism therefor; a stop carried by said feed-table; a stopping-lever movable from an idle to a working position; an automatic locking-lever for locking the reversing-lever in its working position; and a stopping-lever-actuating member carried by the locking-lever and shiftable, by the stop on the feed-table, to return the stopping-lever to its idle position.

28. The combination, with a traveling feed-table, of reversing driving mechanism therefor; a stop carried by said feed-table; a reversing-lever movable from a central, idle position to a working position at either side of such idle position; an automatic locking-lever for locking the reversing-lever in either of its working positions; and a reversing-lever-actuating member carried by the locking-lever and shiftable, by the stop on the feed-table, to return the reversing-lever to its idle position.

29. In a milling-machine, the combination, with a knee and with a cross-feed slide carried by said knee, of driving means; a horizontal shaft carried by said knee and disposed longitudinally of said slide; a gear-wheel splined on said shaft and movable with said slide; a swivel carried by said slide; a vertical shaft journaled in said slide with its longitudinal axis coincident with the axis of rotation of the swivel; a gear-wheel on the vertical shaft and in mesh with the gear on the horizontal shaft; a feed-screw on the swivel and having its axis of movement intersecting the axis of rotation of the swivel; and reversing mechanism between the vertical shaft and the feed-screw.

30. In a milling-machine, the combination, with a rotatable swivel, of a feed-screw mounted on the swivel and having its axis of movement intersecting the axis of rotation of the swivel; a feed-table mounted to travel on said swivel; and a detachable bearing supported on the feed-table at one end of the latter and having a journal-opening for one end of the feed-screw.

31. In a milling-machine, the combination, with a rotatable swivel, of a feed-screw mounted on the swivel and having its axis of movement intersecting the axis of rotation of the swivel and supported at one end in, and adapted to be withdrawn from, a detachable bearing; a feed-table mounted to travel on said swivel; a detachable bearing supported on the feed-table at one end of the latter and having a journal-opening for one end of the feed-screw; and an operating-handle detachably connected with that end of the feed-screw which is supported in the detachable bearing.

32. In a milling-machine, the combination, with a knee and with a cross-feed slide carried by said knee, of driving means, a horizontal shaft carried by said knee and disposed longitudinally of said slide; a gear-wheel splined on said shaft and movable with said slide; a swivel carried by said slide; a vertical shaft journaled in said slide with its longitudinal axis coincident with the axis of rotation of the swivel; a gear-wheel on the vertical shaft and in mesh with the gear on the horizontal shaft; a feed-screw on the swivel and having its axis of movement intersecting the axis of rotation of the swivel; a feed-table mounted to travel on said swivel; and a detachable bearing supported on the feed-table at one end of the latter and having a journal-opening for one end of the feed-screw.

33. In a milling-machine, the combination, with a support, of a swivel mounted for rotation on said support and having a peripheral groove; a circuit of bored studs carried by the support and having mutilated heads engaging the lower wall of said groove; and cam-bolts seated in the support and passing through the bores in said studs.

34. In a milling-machine, the combination, with a support, of a swivel mounted for rotation on said support and having a peripheral groove; a circuit of bored studs carried by the support and having mutilated heads engaging the lower wall of said groove; cam-bolts seated in the support and passing through the bores in said studs; and holding means for preventing longitudinal movement of said cam-bolts.

35. The combination, with a journaled support, of a rotary feed member journaled in said support and held against longitudinal movement and having stopping means; an indicating-dial mounted on said feed member and in engagement with said stopping means; a washer keyed on said feed member; and a screw-threaded collar on said feed member and adapted to bind the washer against said indicating-dial.

36. The combination, with a rotary driving member and with a rotary driven member mounted thereon, of a spline connecting said members for rotation in unison; and a duplex fastening device the main member of which is secured to, and is adjustable in, one of said

rotary members, and the other member of which is carried by such main member and is adjustably secured to the spline.

37. The combination, with a rotary driving member and with a rotary driven member mounted thereon, of a spline connecting said members for rotation in unison; and a duplex fastening device comprising a tubular screw seated in, and adjustable in, the rotary driven member, and a screw-bolt journaled in the tubular screw and threaded into the spline.

CHARLES C. TYLER.
CARL L. GROHMANN.

Witnesses:
RICHD. F. DOW,
HENRY BISSELL.