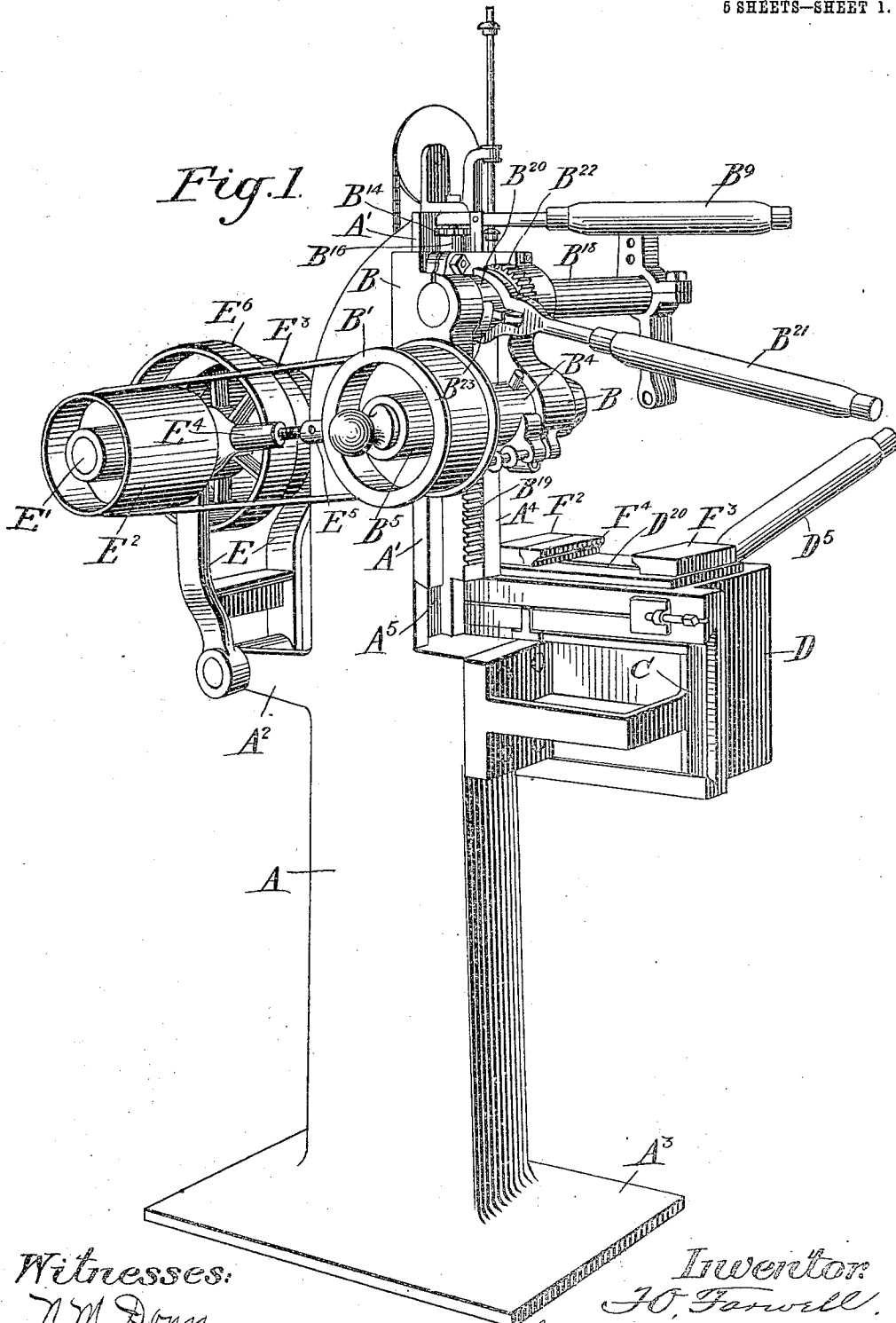


F. O. FARWELL.
MILLING MACHINE.
APPLICATION FILED DEC. 9, 1908.

958,243.

Patented May 17, 1910.

5 SHEETS—SHEET 1.



Witnesses:

N. M. Dunn.

[Signature]

Inventor

F. O. Farwell.

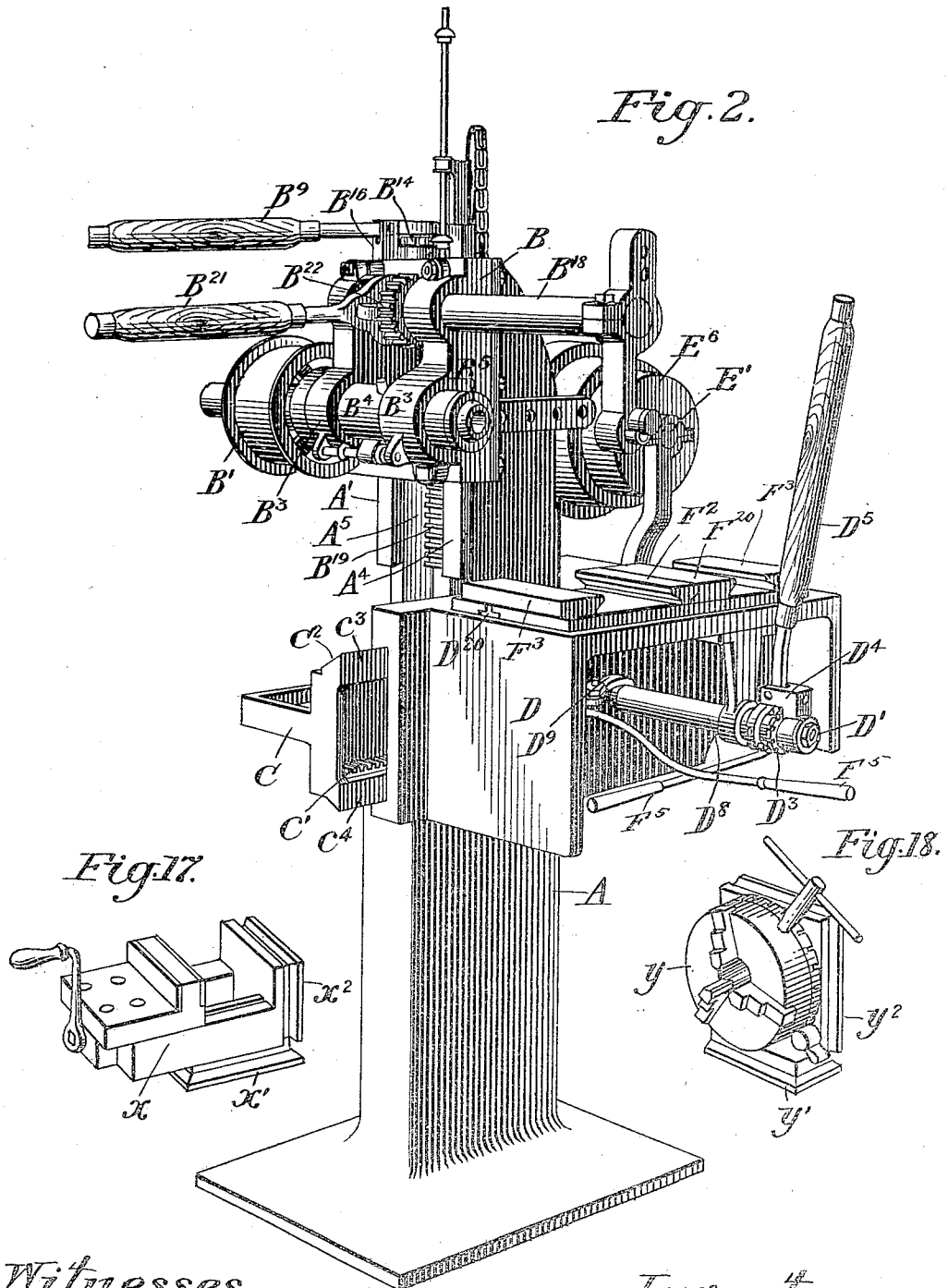
[Signature]
H. M. Goldborough, Mill
attys.

F. O. FARWELL.
MILLING MACHINE.
APPLICATION FILED DEC. 9, 1908.

958,243.

Patented May 17, 1910.

5 SHEETS—SHEET 2.



Witnesses:
N. M. Down.
R. B. Smith.

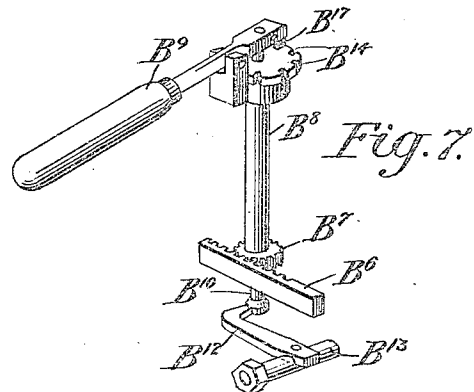
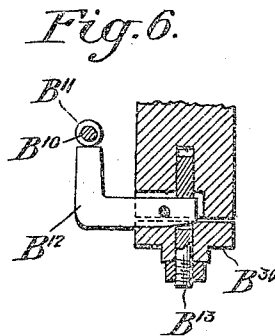
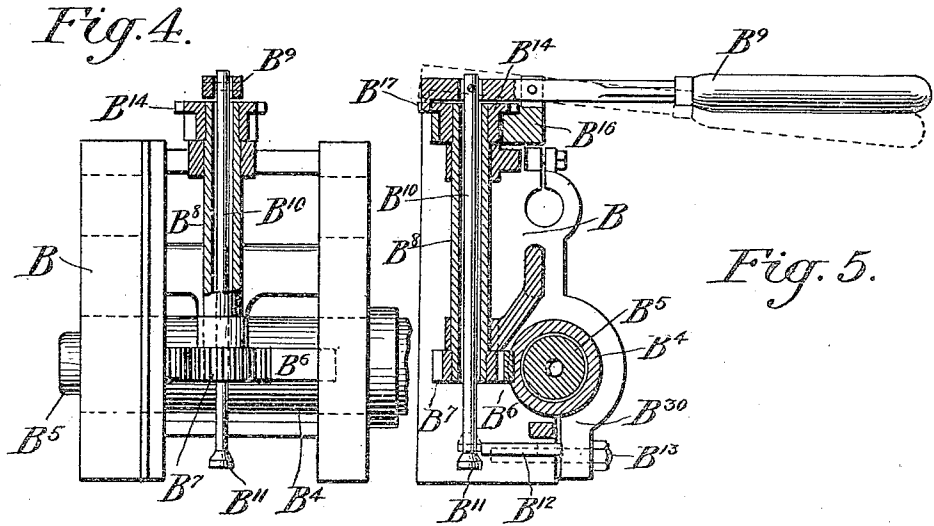
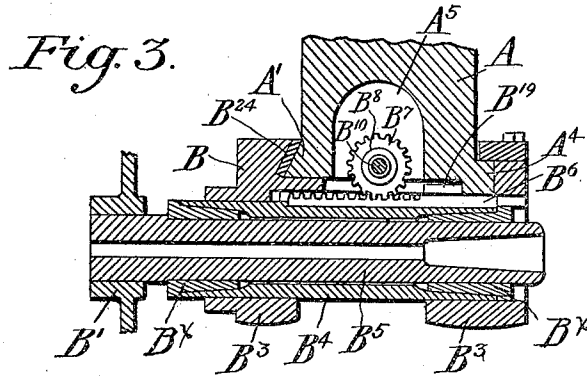
Inventor:
F. O. Farwell.
by Louis Goldbrough, Atty.

F. O. FARWELL.
MILLING MACHINE.
APPLICATION FILED DEC. 9, 1908.

958,243.

Patented May 17, 1910.

5 SHEETS—SHEET 3.



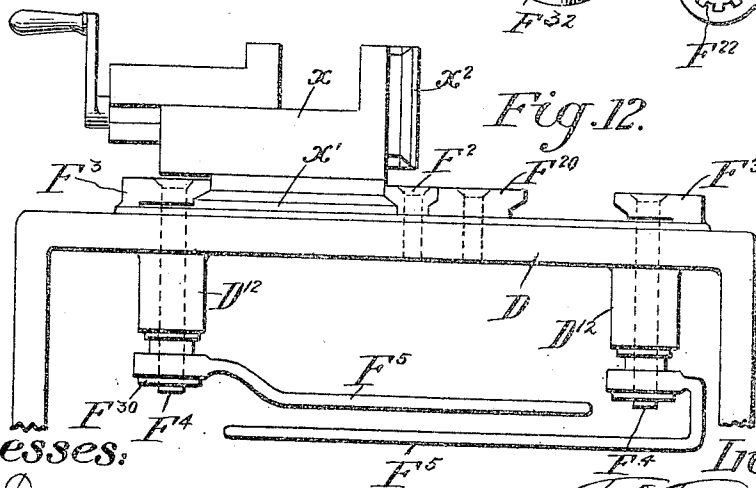
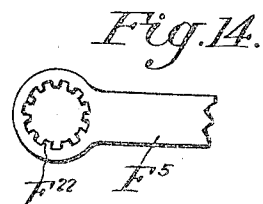
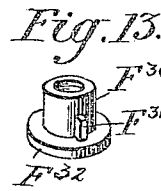
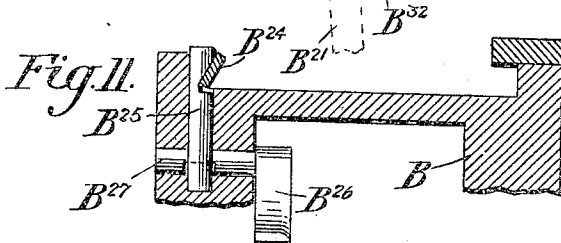
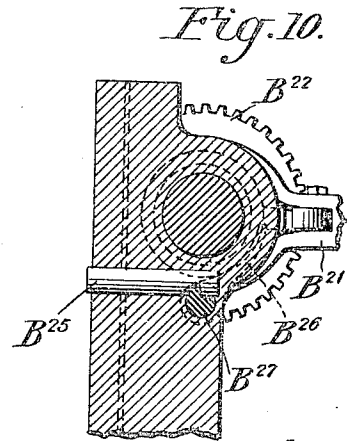
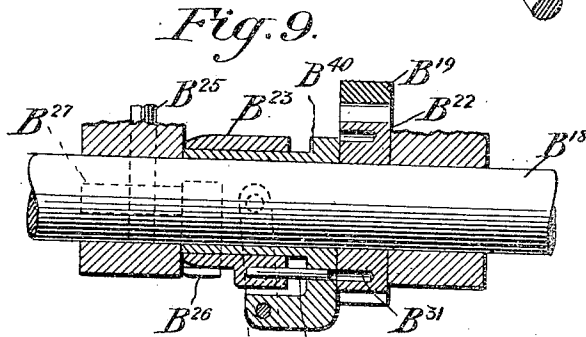
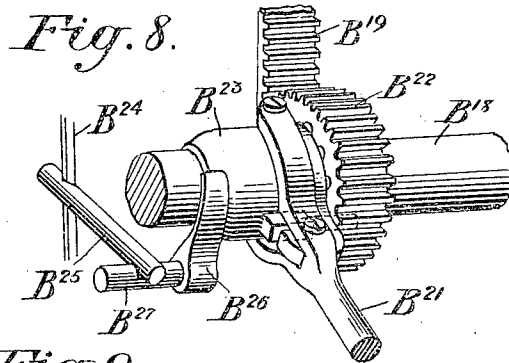
Witnesses:
N. M. Down.
[Signature]

Inventor.
F. O. Farwell.
by *[Signature]*
attys.

958,243.

F. O. FARWELL.
MILLING MACHINE.
APPLICATION FILED DEC. 9, 1908.

Patented May 17, 1910.
6 SHEETS—SHEET 4.



Witnesses:
N. M. Dunn
R. E. Smith

Inventor
F. O. Farwell
by *James H. Brown* Miller

UNITED STATES PATENT OFFICE.

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

MILLING-MACHINE.

958,243.

Specification of Letters Patent.

Patented May 17, 1910.

Application filed December 9, 1908. Serial No. 466,716.

To all whom it may concern:

Be it known that I, FAY O. FARWELL, a citizen of the United States, residing at Dubuque, county of Dubuque, Iowa, have invented certain new and useful Improvements in Milling-Machines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The invention relates particularly to that class of milling machines, in which various movements and adjustments of the tool and the work relatively to each other are effected manually by the operator, and has for its object to provide a machine of this character which is simpler in construction, more efficient in operation and less liable to wear, derangement and deterioration under the heavy service imposed upon it than any other machines heretofore devised for the same general operations.

To this end the invention comprises a machine having a vertically adjustable spindle head, a horizontal tool holding spindle horizontally adjustable in said head, a table for supporting the work and adjustable at right angles to the adjusting movements of the spindle head and spindle, and means, each including an adjusting lever adapted to be manually operated, whereby the head, the spindle and the table may be independently moved or adjusted by the appropriate lever when the latter is moved to one position, and said parts are locked in such adjusted position by another movement of the lever, so that the adjustment and fixing of any of said parts may be performed by one hand of the operator with exactness and expedition and under conditions that insure absolute accuracy of adjustment of the parts during the entire operation of the tool upon the work and complete suppression of vibration, lost motion and back lash in the machine parts.

In the accompanying drawings, Figure 1 is a perspective view of a machine embodying the invention. Fig. 2 is a similar view looking from the opposite side. Fig. 3 is a horizontal section through the spindle head. Fig. 4 is a rear elevation, partly in section, of the spindle head. Fig. 5 is a vertical transverse section through the spindle head.

Fig. 6 is a detail of the means for locking the spindle to the head. Fig. 7 is a detail perspective view of the means for adjusting and locking the spindle. Fig. 8 is a perspective view of the means for adjusting and locking the spindle head. Fig. 9 is a longitudinal section through the mechanism illustrated in Fig. 8. Fig. 10 is a vertical transverse section through the spindle head showing the lock. Fig. 11 is a horizontal section through the same showing the lock in plan. Fig. 12 is a side elevation of the work supporting table. Figs. 13 and 14 are detail views of the locking lever mechanism for the table clamps. Fig. 15 is a perspective of the table and its support. Fig. 16 is a transverse vertical section through the same. Fig. 17 is a perspective view of a convenient form of work holding vise or clamp for use in connection with the machine. Fig. 18 is a perspective view of a centering chuck to be secured to the table.

Referring to the drawings A, Figs. 1 and 2, indicates a column or support for the machine, the lower end of which is provided with a broad flat base by means of which it is secured to the floor or other foundation. The upper front portion of said column is provided with finished guideways or slides upon which is mounted, for vertical adjustment, a spindle head or carriage B, and about midway of the height of the column there is provided a rail or guiding support C, which may be formed either integrally with the column or as a separate element suitably secured to said column, said rail C constituting a support upon which a work holding table D is adjustable horizontally. Said rail C has its front vertical faces C³ and C⁴ and upper and lower rearwardly inclined flanges or edges finished smooth to engage the rear wall and oppositely inclined flanges of the table D with a snug fitting dovetail joint, which admits of the table being freely slid along the rail, and, because of the broad bearing surface between the front face of the rail and the rear face of the table and the relatively long bearing between the flanges of the rail and table, completely suppresses any lost motion and tendency of the table to sag out of its proper horizontal adjustment, the bearing surfaces between the rail and table being held in close and accurate contact by the weight of

the table. Upon the lower inclined flange of the rail C is secured a gib or wear strip C⁵, (see Fig. 16).

The spindle head or carriage B comprises
 5 a frame-like casting, the rear wall of which is provided with suitable flanges which engage and slide upon the rails or guides A', A⁴ on the upper face of column A, and the side walls of which are provided with
 10 alining bearings for a loose shaft B¹⁸ and a longitudinally adjustable spindle B⁵. Both the upper bearings for the shaft B¹⁸ and the parallel lower bearings B³ for the spindle B⁵ are formed in part by cap pieces or cover
 15 plates B³⁰ which are either secured to the body of the head or carriage B by bolts or formed integrally with said body and slotted above the upper bearings, so that when the bolts are set up the shaft B¹⁸ is clamped
 20 in place. In case the cap pieces are formed integrally with the carriage, the right hand bearing for spindle B is similarly slotted to permit bolt B¹³ to clamp the spindle and its quill against longitudinal movement as
 25 will be hereinafter particularly explained. The spindle B⁵, as indicated, is journaled in a quill B⁴ which is slidably mounted in the bearings B³ in the carriage, and between the said quill B⁴ and the spindle B⁵ are inter-
 30 posed cone bushings B^x (see Fig. 3) which serve to take up all wear between the spindle and quill. The quill B⁴ is provided on its rear face with a rack B⁶ which is operatively engaged by a pinion B⁷ to adjust the
 35 quill and the spindle longitudinally in the bearings B³.

On the outer end of the spindle B⁵ is secured a driving pulley B⁷ which is engaged by driving belt E³ which in turn passes over
 40 a relatively long pulley E² mounted on a countershaft E'. Said countershaft E' is journaled in swinging bracket E which is pivoted to an arm A² extending rearwardly from the column A. Mounted on the shaft
 45 E' is a cone pulley E⁶ adapted to engage a belt from a similar pulley mounted on a power shaft located at any appropriate point. In order to keep the driving belt E³ sufficiently tight to transmit power from the
 50 shaft E' to the spindle B⁵, there is provided an adjusting rod E⁴ provided with a nut or turn buckle E⁵, by means of which the shaft E' and the spindle B⁵ are rigidly and adjustably connected. It will be apparent
 55 that by operating the nut or turn buckle E⁵ the shaft E' may be adjusted toward or from the spindle B⁵.

The longitudinal movement of the quill B⁴ and spindle B⁵ is effected and controlled
 60 by means of pinion B⁷ which engages rack B⁶. Said pinion B⁷ is mounted on a hollow shaft B⁸ journaled in vertical alining bearings in the spindle carriage B, as more particularly illustrated in Figs. 4 and 5.
 65 On the upper end of said spindle B⁸ is se-

cured a notched head B¹⁴ upon which is swiveled a collar B¹⁶ in which is pivoted a handle B⁹, the inner end of which is provided with a tooth or finger B¹⁷ adapted to engage the notches in the head B¹⁴ when the
 70 handle is in elevated position, and turn the shaft B⁸ backward or forward. When the handle B⁹ has been moved laterally in either direction to the limit of its throw, said handle may be released or moved downward to
 75 disengage tooth B¹⁷ from the notched head B¹⁴, after which the handle is moved backward and again elevated to engage another notch in the head B¹⁴ to complete the rotary movement of said head B¹⁴ and shaft B⁸ to effect the desired adjustment of quill B⁴
 80 and spindle B⁵ in either direction.

The handle B⁹ normally occupies the position indicated in dotted lines in Fig. 5, viz. with its outer end depressed and its inner end elevated, and this action of the handle B⁹ is availed of as affording an efficient means for locking the spindle B⁵ and the quill B⁴, in which it is journaled, in adjusted position in the spindle carriage B.
 90 To produce this locking effect there is provided a vertically movable rod B¹⁰ which passes through the hollow spindle B⁸ and is connected to hand lever B⁹ at its upper portion, so that when the outer end of said
 95 lever falls, the rod B¹⁰ is lifted, thereby causing a cone-shaped cam piece B¹¹ on the lower end of said rod B¹⁰ to engage the end of an angle lever B¹², which is pivoted near the forward edge of the carriage B and is engaged at its other end in a slot in bolt B¹³
 100 which holds one of the cover plates or cap pieces B³⁰ to the carriage. When the cam piece B¹¹ engages angle lever B¹², the latter is moved on its pivot, thereby drawing the bolt B¹³ inward and causing cap piece B³⁰ to tightly engage the quill B⁴ and lock the same in position, so that said quill and the spindle B⁵ journaled therein, are rigidly held against longitudinal movement. The
 110 reverse or lifting movement of the handle B⁹ moves the rod B¹⁰ downward to disengage cam piece B¹¹ and angle lever B¹², which has the effect of releasing the clamping engagement between cap piece B³⁰ and the quill, so that a subsequent horizontal
 115 movement of the handle B⁹ in either direction will be effective in rotating shaft B⁸, pinion B⁷ and thereby adjusting the horizontal position of the quill and the spindle
 120 in the carriage B, as hereinbefore explained.

As hereinbefore indicated, means are provided for adjusting the spindle carriage B vertically on the column A to bring the tool
 125 in proper position to engage the work and also to admit of a vertical feed of the tool with respect to the work. In order to admit of these operations being quickly and readily effected by the workmen, there is provided on the face of column A, in the
 130

rear of the carriage B, a stationary rack B¹⁹ which is adapted to be engaged by a pinion B²² loose on the shaft B¹⁸. Also loosely mounted on said shaft B¹⁸ is a collar B⁴⁰, to which is pivoted for laterally swinging movement a hand lever B²¹, the inner forked end of which is connected by pivot screws with a sliding cone collar B²³ which is mounted on the collar B⁴⁰ and capable of longitudinal movement on the same. The pinion B²² is provided on its side adjacent collar B⁴⁰ with a peripheral series of sockets B³¹ which are adapted to be engaged one at a time by a pin B³² carried by the collar B²³ and passing through an opening in collar B⁴⁰, as clearly illustrated in Fig. 9, thereby effectively locking the collar B⁴⁰, and associated hand lever B²¹ to pinion B²². After the hand lever is thus locked to the pinion B²², vertical movement of said hand lever will rotate the pinion on the shaft, and as said pinion engages the stationary rack B¹⁹, the effect will be to raise or lower the spindle head or carriage B to the desired extent. To effect this locking movement the hand lever B²¹ is moved to the left. To release the engagement between the pinion B²² and hand lever B²¹, the latter is swung to the right which has the effect of moving the pin B³² from pinion B²² and at the same time sliding the cone collar B²³ to the left. This movement of the cone collar effects a locking of the carriage to the standard or column A by the following means. Pivoted in the left hand side frame of carriage B is a short shaft B²⁷ upon the outer end of which is secured a finger B²⁶, so that when said collar is moved to the left the finger B²⁶ is vertically rotated toward the front of the machine. The shaft B²⁷ is notched intermediate its length to provide a rib or shoulder which engages a notch in a locking rod B²⁵, which is slidably mounted in the side frame of the carriage B and is provided near its outer end with a beveled notch which coöperates with a gib or liner B²⁴ which is secured to the left hand guideway A' of the standard, so that when the rod B²⁵ is drawn forward by the coaction of cone collar B²³, finger B²⁶ and shaft B²⁷, the beveled face of the notch in said rod B²⁵ is clamped against the gib B²⁴ and securely locks the carriage B against vertical movement. To release this lock, it is only necessary to swing lever B²¹ to the left, thereby retracting cone collar B²³, and at the same time causing pin B³² to engage one of the sockets B³¹ in pinion B²². It will therefore be seen that whenever the handle B²¹ is operatively engaged with the pinion B²² to adjust the stationary carriage, the lock between the carriage and the column is released, and conversely, whenever the handle and pinion are disengaged, the lock is rendered operative to prevent any movement of

the carriage on the standard. This latter circumstance admits of the carriage being quickly and accurately adjusted to any desired position. For example, should a single movement of lever B²¹ in a vertical plane be found insufficient to adjust the carriage to the desired position, it is necessary only to swing the lever to the right, thereby locking the carriage and then move the lever to the desired position to engage another socket or recess in the side of pinion B²², after which the lever is again swung to the left and subsequently moved in a vertical plane to continue the rotary movement of the pinion B²².

The horizontal adjustment and the locking of the work holding table D is also effected by successive movements of a single hand lever D⁵. It will be noted that the table D is formed as a hollow casting, without a front wall or bottom, and that the carriage is rigidly supported on the rail C, as hereinbefore particularly explained. Journaled in the rear wall of said table D and in a pendent bracket attached to the lower side of the table top is a shaft D', on the inner end of which is secured a pinion D² which meshes with a rack C' secured to the rail C, as clearly indicated in Figs. 2, 15 and 16. On the other end of the shaft D' there is secured a notched collar D³, generally similar to the collar B¹⁴ employed in connection with the spindle adjusting means. Rotatably mounted on said collar D³ is a second collar D⁴ on which the handle D⁵ is pivoted, and the latter has a dog or finger D⁶ on its lower end which coöperates with the notches in the collar D³ to rotate the same and the attached shaft D', which has the effect of rotating pinion D² against the stationary rack C', thereby adjusting the table D longitudinally of the rail C. Obviously if a single rotatory movement of lever D⁵ is not sufficient to move the table to the extent desired, it is only necessary to swing said lever to the right to disengage dog D⁶ from the notched collar D³, and then move said lever in a reverse direction to engage another notch in said collar D³, after which the adjusting movement of said lever may be continued.

Surrounding the shaft D' is a sleeve D⁸, the inner end of which is tapered, and the outer end of which is pinned to the lever D⁵, so that when the latter is moved to the right, to the position indicated in dotted line in Fig. 16, the sleeve D⁸ is moved inward, causing the tapered end thereof to engage a pivoted finger D⁹, mounted on the rear wall of the table, which finger engages a hook rod D¹⁰, the lower end of which is adapted to be drawn into clamping engagement with the gib C⁵ on the lower face of rail C, thereby rigidly locking the table to the rail, in a manner quite similar to the

operation of the device for locking the carriage to the column.

In milling machines as heretofore constructed, it has been customary and necessary to secure the chucks and fixtures to the table by means of bolts held in T-slots formed in the table. This necessitated the use of wrenches and special tools for locking the chucks and fixtures in position and the operation of securing and adjusting the work on the table was slow and difficult. In the present invention, special means are provided for effecting a quick and ready attachment and adjustment of the work holding vises, chucks or like elements to the table, and to accomplish this purpose, I provide the top of the table with clamping members F^3 at each end of the table, which members run transversely of the table and cooperate with stationary clamping means F^2 and F^{20} located intermediate the length of the table. The inner edges of the clamping elements F^3 , F^3 are adapted to be drawn down toward the surface of the table by means of bolts F^4 which pass through the bodies of the clamps and through the bearings D^{12} on the under face of the table. On the lower end of each of the bolts F^4 is mounted a nut F^{30} provided with a flange F^{32} and a lug F^{31} , and surrounding the nut and supported by the flange thereon is a handle F^5 provided with a series of notches F^{22} about the peripheral edge of the socket which fits over the nut F^{30} , which notches are adapted to be engaged by the lug F^{31} to permit the nut to be turned up and down on the screw threads of the bolt F^4 , thereby tightening or loosening the clamp F^3 . It will be noted that by simply raising the lever F^5 on nut F^{30} to disengage lug F^{31} from notches F^{22} , the lever may be turned to engage said lug F^{31} with another notch. This admits of the levers F^5 being adjusted so as to lie out of the way under the table. The work holding vises or chucks, which may be of any suitable character or form and which are typically represented by the constructions shown in Figs. 17 and 18, are provided with base portions X' and X^2 in Fig. 17, and Y' and Y^2 in Fig. 18, the edges of which are beveled to fit under the oppositely beveled edges of the clamping members F^3 and F^2 or F^3 and F^{20} on the table, as indicated in Fig. 12. For example, taking the clamping vise X , indicated in Fig. 12, it will be seen that the larger base portion X' is adapted to fit under and be engaged by the clamping members F^3 and F^2 . Should it be found desirable to use the vise in upright position, the foot piece X^2 may be engaged under the beveled edges of the right hand clamping member F^3 and stationary clamp F^{20} . By operating the levers F^5 , the work holding chucks, vises or the like may be immediately clamped in po-

sition on the table or quite as readily released.

From the foregoing description it will be apparent that the entire adjustment and operation of the machine to perform any character of work possible on machines of this general type may be effected by simple, direct movements of the hand levers B^3 , B^{21} and D^3 . As both the vertical and transverse feeds of the cutter are independent of the table, or the weight of the work upon the table, small cutters may be sensitively fed both in and down, with heavy or bulky work upon the table without danger of breaking the cutters. Furthermore, the adjustment of the table feed is readily effected whether the work on the table be heavy or light. The feed levers not only move the table, the spindle and the head or carriage, but also lock these elements by a simple angular movement of said levers. The spindle head is preferably counterbalanced by adjustable weights in the column, so that by regulating the weights the movement of the spindle head or carriage up or down may be made substantially automatic, that is to say, by removing part of the weights, the spindle head will move down by gravity when it is released from its locking engagement with the carriage, and by adding to the weights until the latter overbalance the spindle head or carriage, the latter will be fed up. By means of the special clamping device on the table, the old forms of cumbersome, slow and troublesome work holding devices may be entirely dispensed with. In short, the machine as hereinbefore described is designed to perform quickly and accurately, not only the small work usually done on hand milling machines, but to perform accurately and more expeditiously, much of the work usually done on shapers, on the larger and more expensive power fed milling machines, or on profilers and cam cutting machines.

What I claim is:—

1. In a milling machine, the combination of a fixed member, a slidable member, rack mechanism for adjusting said members with respect to each other, mechanism to lock the movable member in adjusted position, and a lever having different movements to effect the operation of the rack mechanism and the locking member respectively.
2. In a milling machine, the combination with relatively fixed and slidable parts, of means for adjusting the sliding part and locking it in position, said means comprising a rack and pinion, a lock, and means which when moved in one direction engages the pinion and when moved in the other direction disengages the pinion and operates the lock.
3. In a milling machine, the combination with relatively fixed and slidable parts, of

means for adjusting the sliding part and locking it in position, said means comprising gearing for moving the parts, a lock, and means movable in one direction to engage one member of the gearing, in another direction to operate the gearing, and in third direction to disengage the gearing and operate the lock.

4. In a milling machine, the combination of a spindle head, a spindle journaled therein, rack mechanism for adjusting the spindle longitudinally, locking mechanism for the spindle, and a single means to operate the rack and locking mechanisms.

5. In a milling machine, the combination of a spindle head, a spindle journaled therein, rack mechanism for adjusting the spindle longitudinally, means to lock the spindle in its adjusted position, and a single lever to operate both the rack mechanism and said locking mechanism.

6. In a milling machine, mechanism for moving and locking the slide elements comprising a rack and a pinion on the relatively movable parts, a lock for securing said relatively movable parts together, a lever, means for connecting the lever with the pinion by one movement of said lever, and means for operating the lock by the opposite movement of said lever.

7. In a milling machine, the combination with fixed and sliding members, of means for adjusting and locking the sliding mem-

ber, comprising a rack, a pinion, a shaft for said pinion, a bracket swiveled on said shaft, a lever pivoted to said bracket, a toothed sleeve secured to the shaft, a dog on the lever to engage the teeth on said sleeve to rotate said sleeve, shaft and pinion, a cam-ended slide carried by the shaft and attached to said lever, and a lock device coöperating with said cam slide and a fixed portion of the machine; whereby the lever serves to engage and operate the gear in one position and to disengage the gear and operate the lock in the opposite position.

8. In a milling machine, the combination with fixed and sliding members, of means for adjusting and locking the sliding member comprising a relatively fixed rack, a movable pinion, a shaft for said pinion, a lever mounted on said shaft, means for connecting the lever and the pinion, a cam ended slide connected to said lever, and a lock device coöperating with said cam slide and a fixed portion of the machine; whereby the lever serves to engage and operate the gear when in one position and to disengage the gear and operate the lock in the opposite position.

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

FAY O. FARWELL.

Witnesses:

FRANK B. HIRD,
GLENN MUFFLY.