(No Model.) 9 Sheets—Sheet 1.

C. W. SPONSEL.

RIFLING MACHINE.

No. 446,898. Patented Feb. 24, 1891.

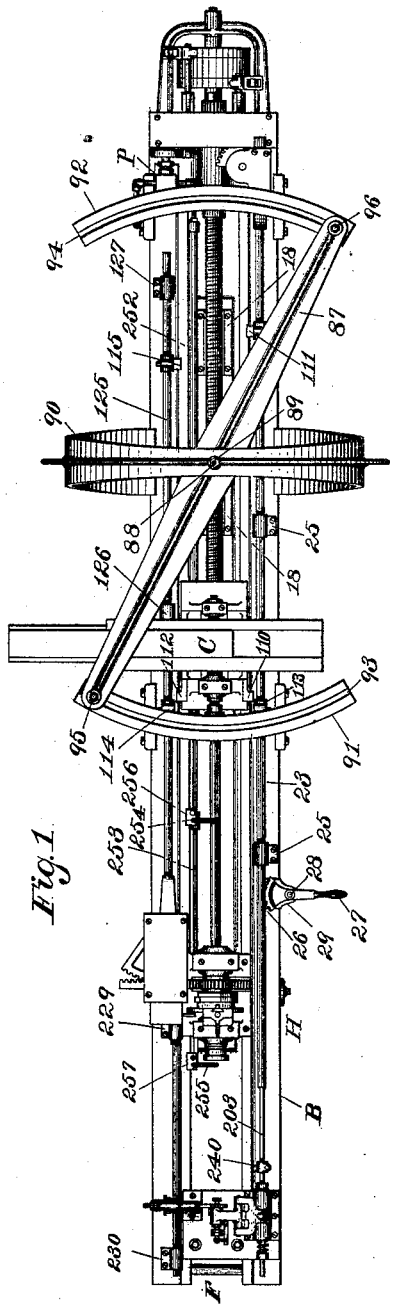


Fig. 1.

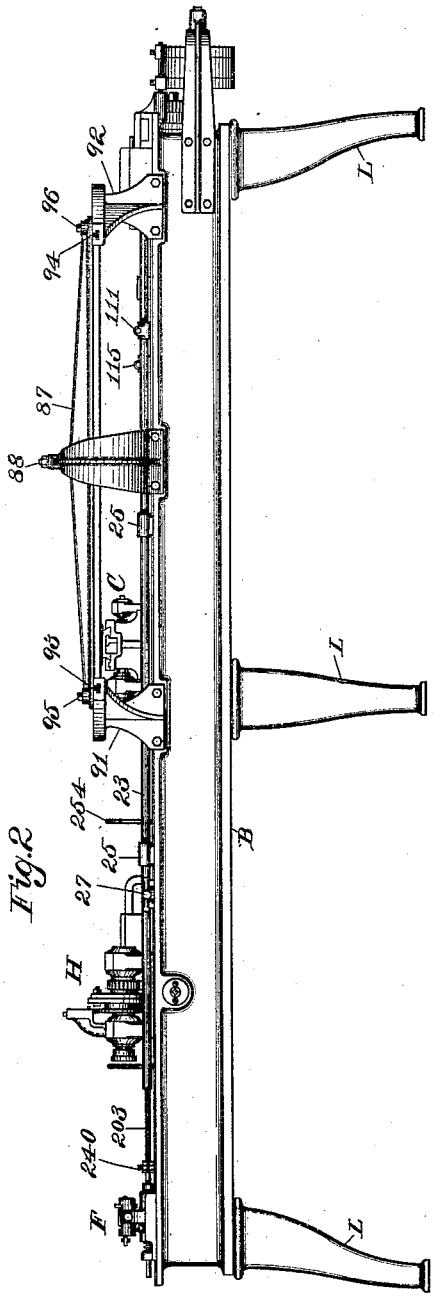


Fig. 2.

Witnesses:
Henry L. Reckard.
Wm. Bjorkman.

Inventor:
C. W. Sponsel.

(No Model.) 9 Sheets—Sheet 2.

C. W. SPONSEL.

RIFLING MACHINE.

No. 446,898. Patented Feb. 24, 1891.

Fig. 3

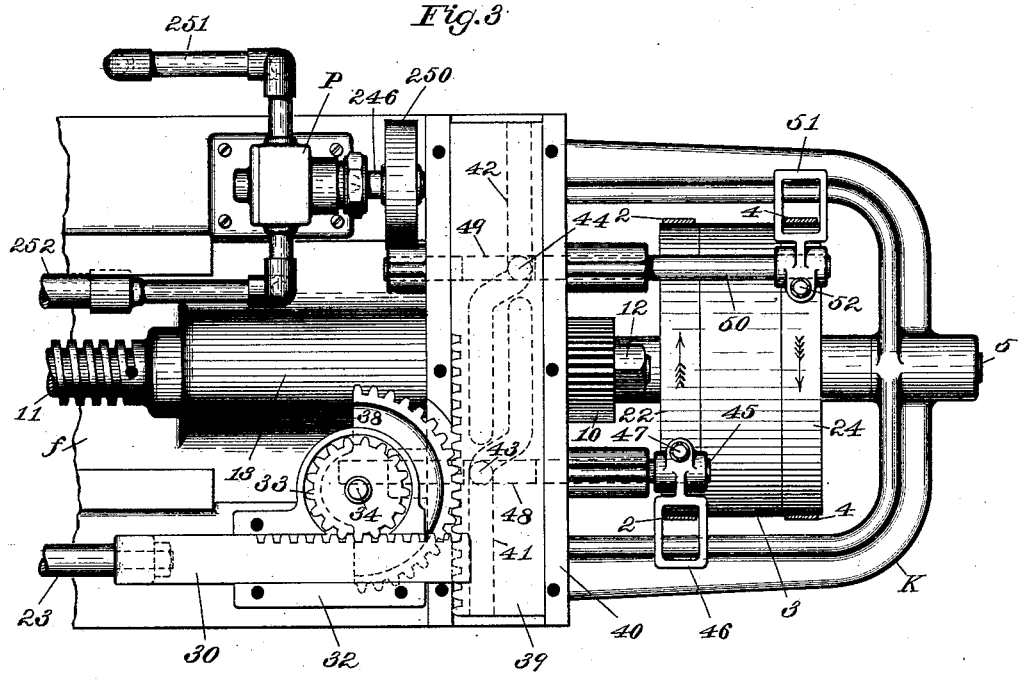
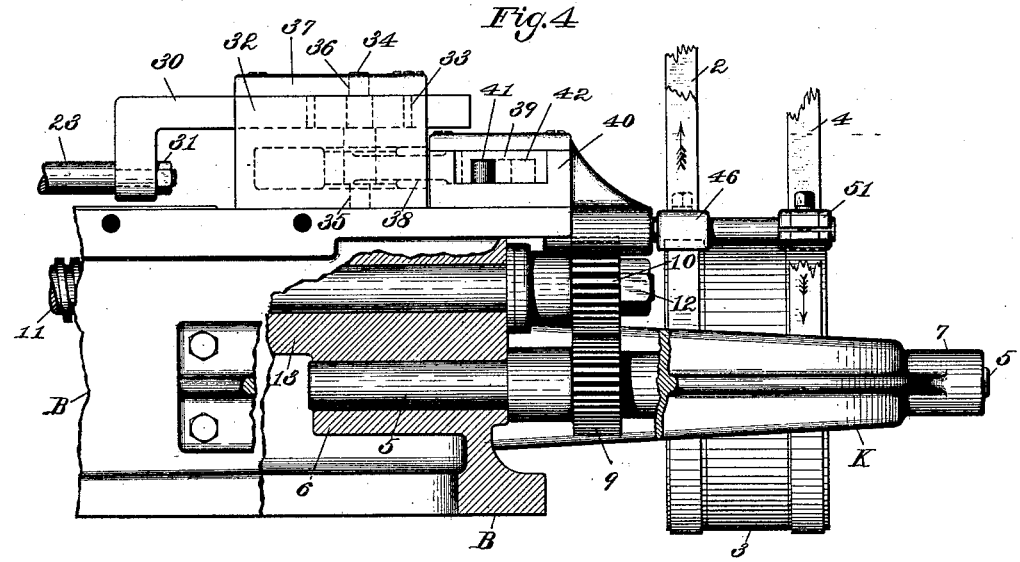


Fig. 4



Witnesses:

Henry L. Reckard.

Wm. Byorkman,

Inventor:

C. W. Sponsel.

(No Model.) 9 Sheets—Sheet 3.

C. W. SPONSEL.

RIFLING MACHINE.

No. 446,898. Patented Feb. 24, 1891.

Fig. 5

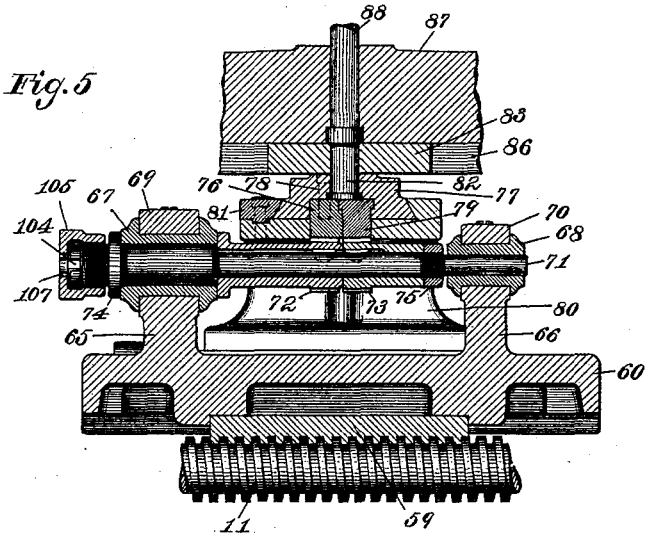
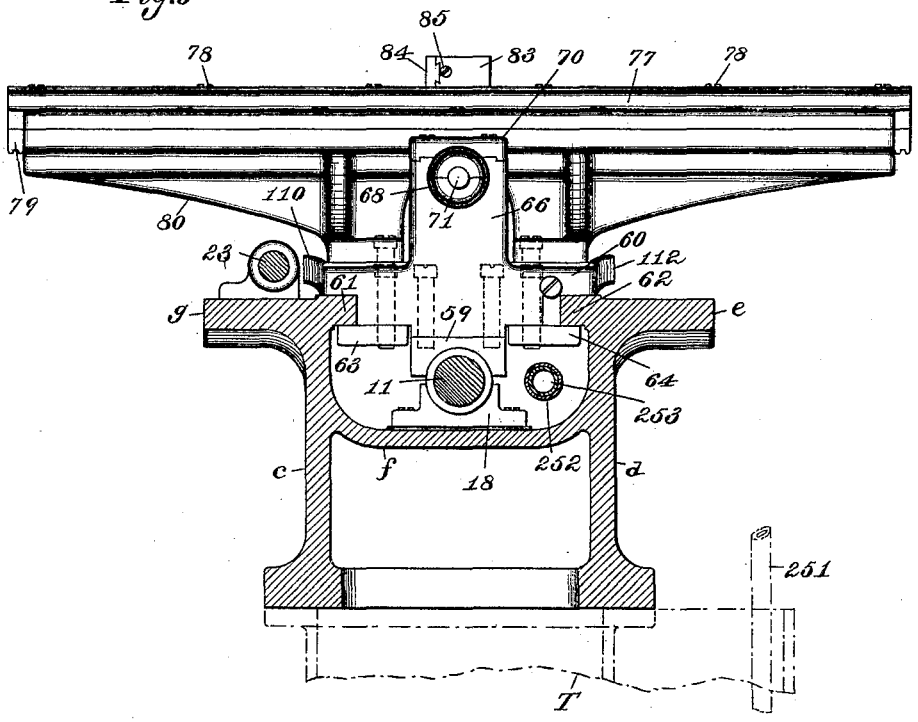


Fig. 6



Witnesses:
Henry L. Ruckard.
W. M. Bjorkman.

Inventor:
C. W. Sponsel.

(No Model.) 9 Sheets—Sheet 4.

C. W. SPONSEL.

RIFLING MACHINE.

No. 446,898. Patented Feb. 24, 1891.

Fig. 7

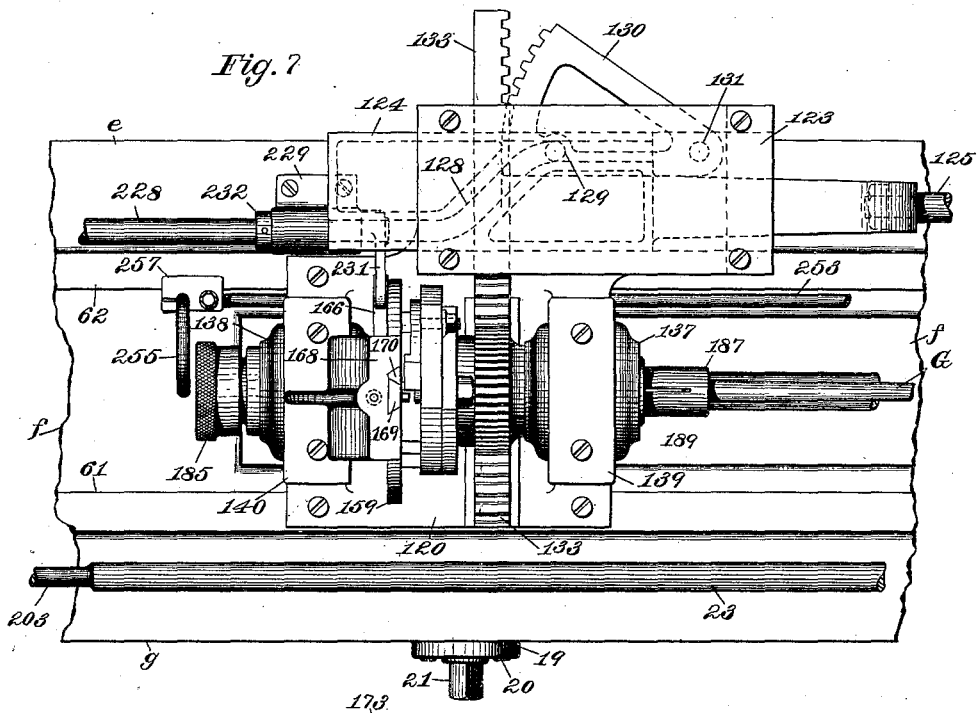
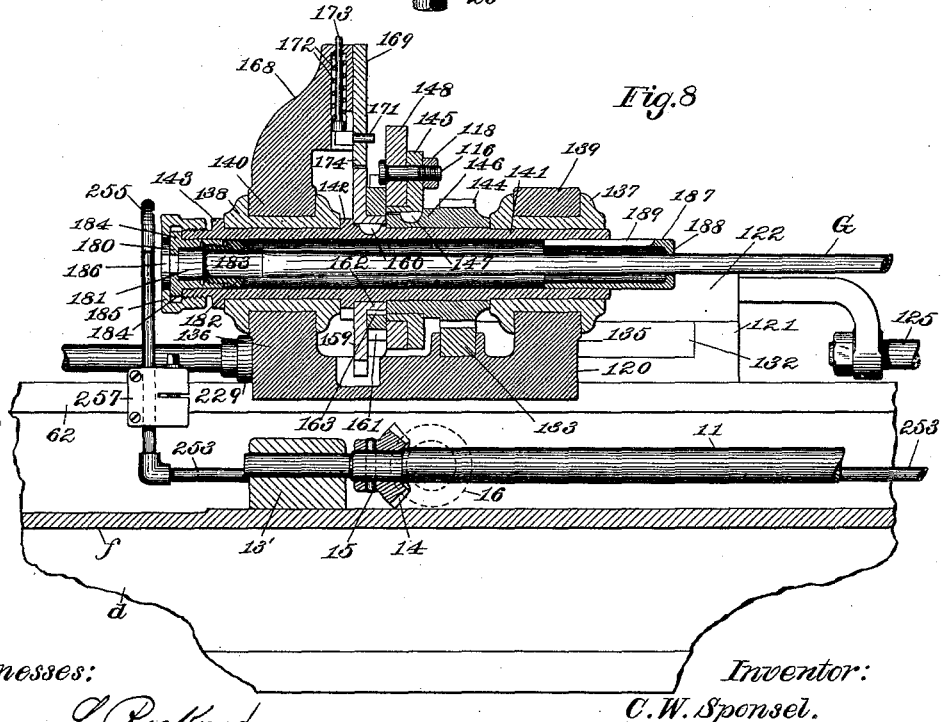


Fig. 8



Witnesses:
Henry L. Ruckard.
Wm. Bryce Mason.

Inventor:
C. W. Sponsel.

(No Model.) 9 Sheets—Sheet 5.

C. W. SPONSEL.

RIFLING MACHINE.

No. 446,898. Patented Feb. 24, 1891.

Fig. 9

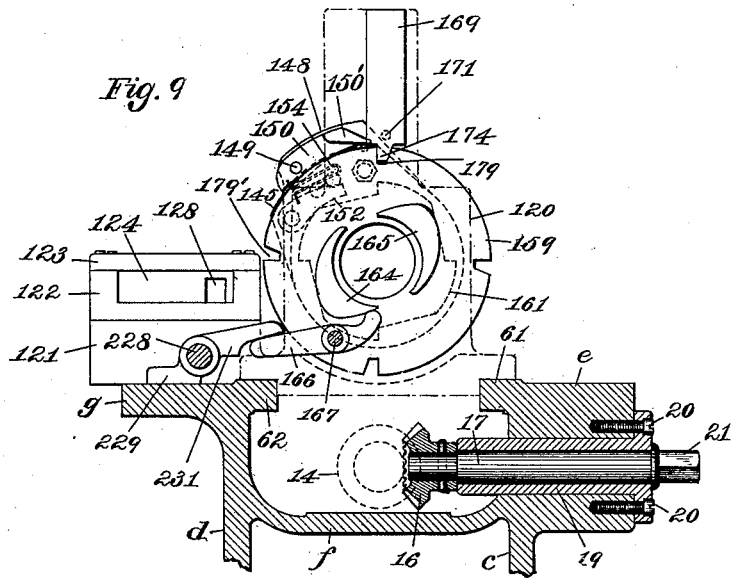


Fig. 10

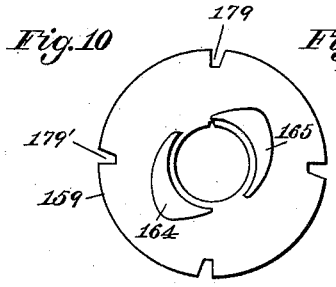


Fig. 11

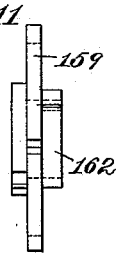


Fig. 12

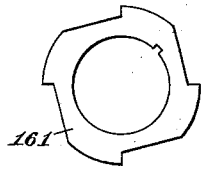


Fig. 13

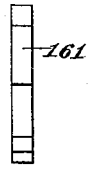


Fig. 14

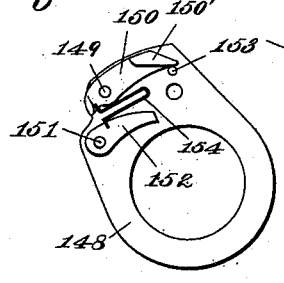


Fig. 15

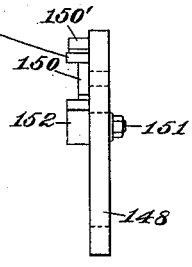


Fig. 16

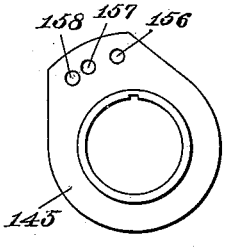
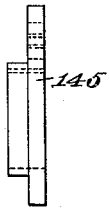


Fig. 17



Witnesses:

Henry L. Reckard.

W. M. Byorkman.

Inventor:

C. W. Sponsel.

(No Model.) 9 Sheets—Sheet 6.

C. W. SPONSEL.

RIFLING MACHINE.

No. 446,898. Patented Feb. 24, 1891.

Fig. 18

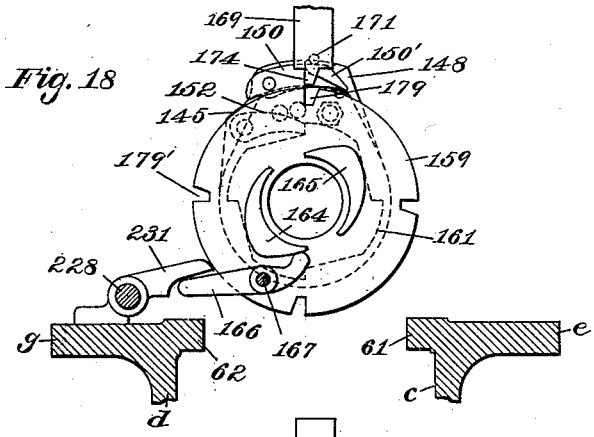


Fig. 19

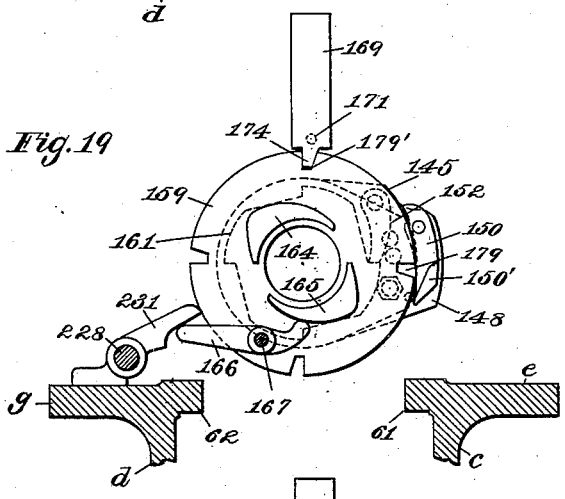
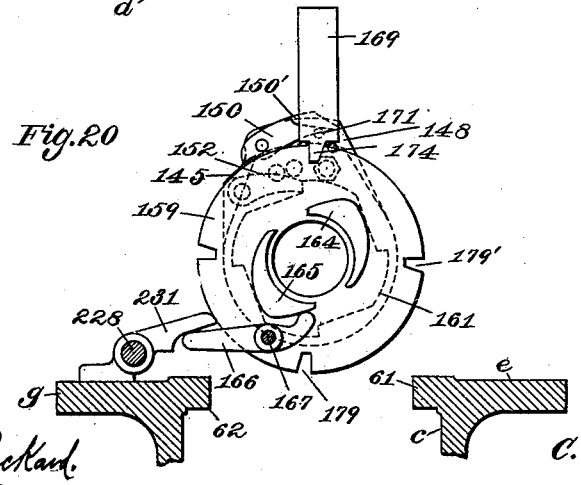


Fig. 20



Witnesses:
Henry L. Reckard.
Wm. Byerkman.

Inventor:
C. W. Sponsel.

(No Model.) 9 Sheets—Sheet 7.

C. W. SPONSEL.

RIFLING MACHINE.

No. 446,898. Patented Feb. 24, 1891.

Fig. 21

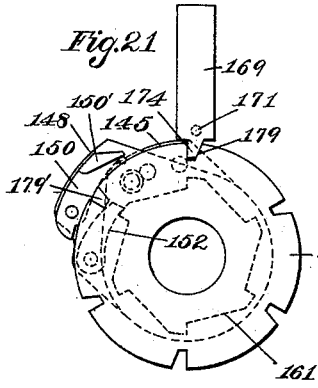


Fig. 22

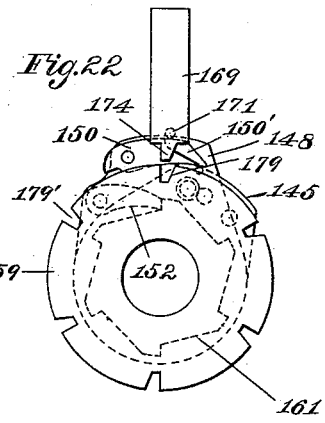


Fig. 23

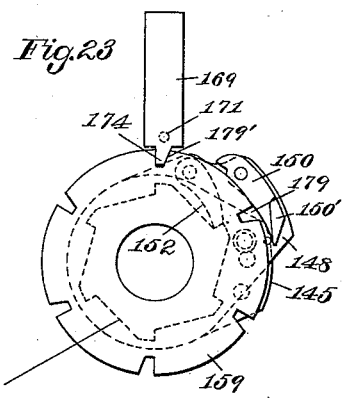


Fig. 34.

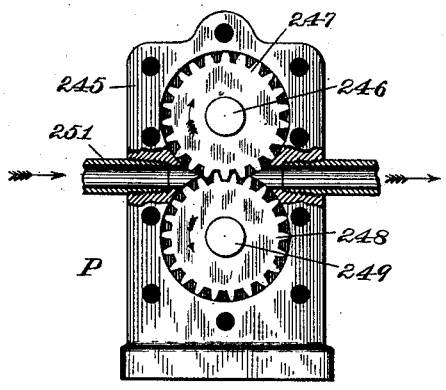
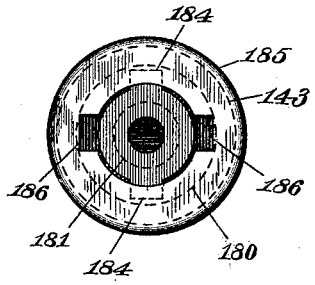


Fig. 35



Witnesses:
Henry L. Reckard.
W. W. Bjorkman.

Inventor
C. W. Sponsel.

(No Model.) 9 Sheets—Sheet 8.

C. W. SPONSEL.

RIFLING MACHINE.

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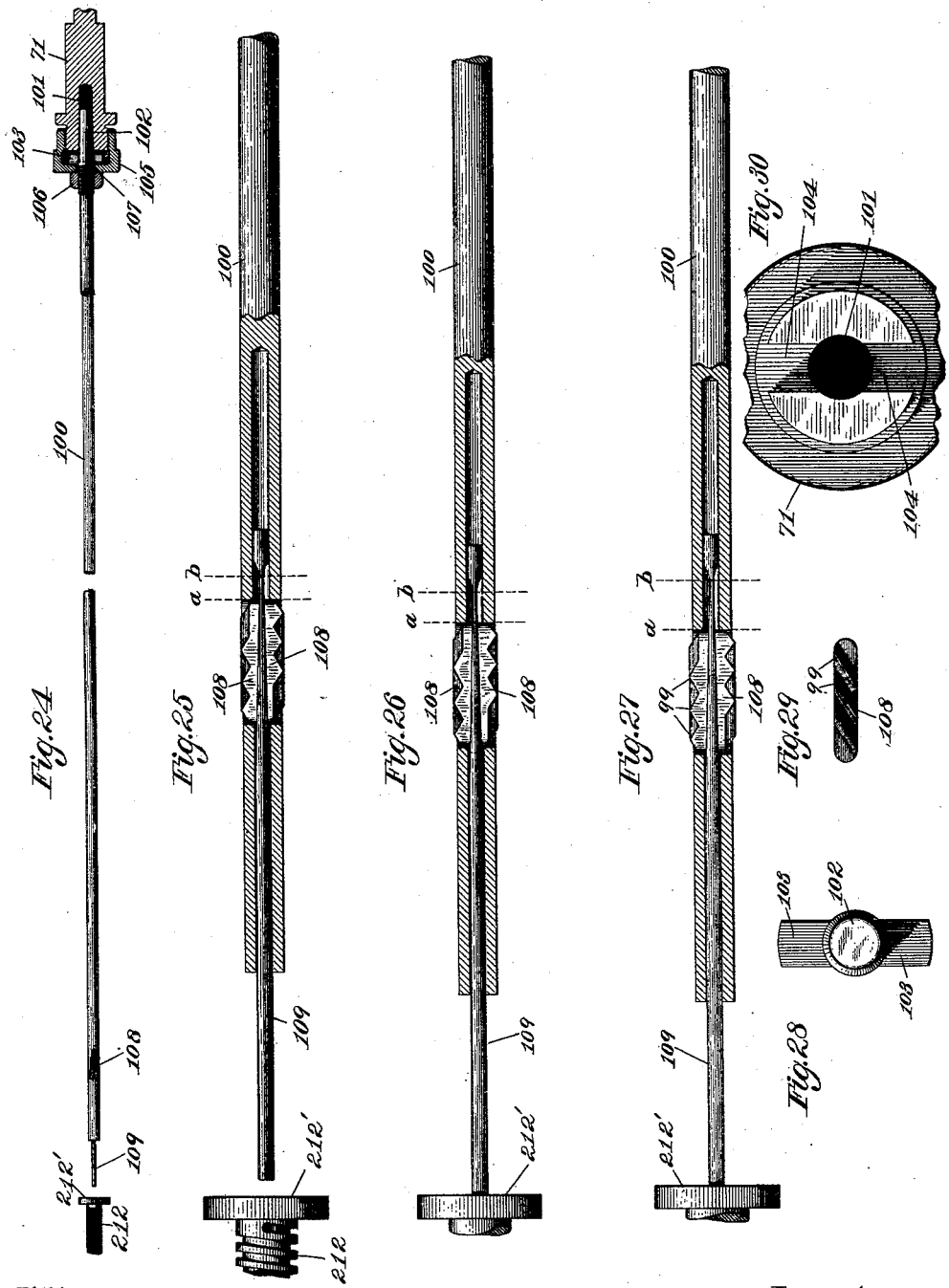


Witnesses:

Henry L. Ruckard.

W. M. Byorkman

Inventor:

C. W. Sponsel.

(No Model.) 9 Sheets—Sheet 9.

C. W. SPONSEL.

RIFLING MACHINE.

No. 446,898. Patented Feb. 24, 1891.

Fig. 31

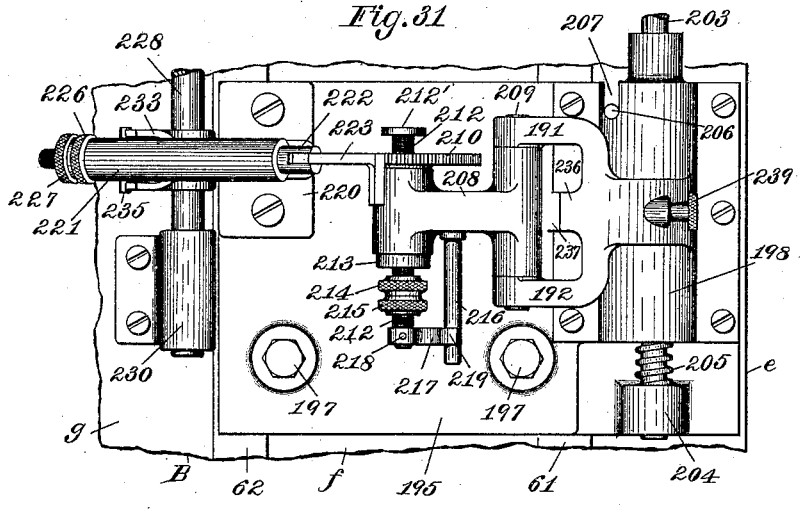


Fig. 32

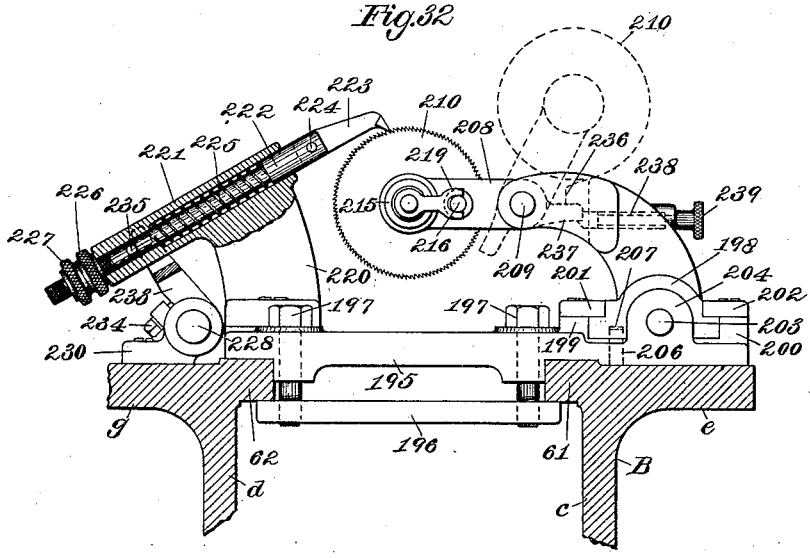
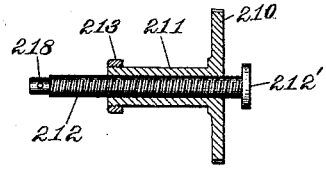


Fig. 33



Witnesses:
Henry L. Reckard.
Wm. Bygbeman.

Inventor:
C. W. Sponsel.

UNITED STATES PATENT OFFICE.

CHARLES W. SPONSEL, OF HARTFORD, CONNECTICUT, ASSIGNOR TO THE PRATT & WHITNEY COMPANY, OF SAME PLACE.

RIFLING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 446,898, dated February 24, 1891.

Application filed October 28, 1890. Serial No. 369,604. (No model.)

To all whom it may concern:

Be it known that I, CHARLES W. SPONSEL, 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 Rifling-Machines, of which the following is a specification.

This invention relates to machines for automatically making the rifle-grooves of gun-barrels, and has for its object to furnish improved and effective means for operating the barrel and the rifling-tool and for feeding said tool to the work.

In the drawings accompanying and forming a part of this specification, Figure 1 is a plan view, drawn on a small scale, of a rifling-machine embodying my invention. Fig. 2 is a front or side elevation of the machine. Fig. 3 is a plan view, on an enlarged scale, of the right-hand end of the machine, showing that portion of the bed carrying the driving mechanism, the shipper mechanism, and the oil-pump. Fig. 4 is a front elevation of the parts shown in Fig. 3, some details being broken away the more clearly to show the construction. Fig. 5 is a longitudinal central vertical section of the carriage. Fig. 6 is an end view of the carriage as seen from the right hand in Fig. 1 and showing a portion of the bed in section. Fig. 7 is a plan view of a portion of the bed of the machine with the parts composing the barrel-carrying head in position thereon. Fig. 8 is a longitudinal central vertical section of the parts shown in Fig. 7. Fig. 9 shows a portion of the bed in section and means for rotating the driving-screw by hand, also an end elevation of the index-plate and accessory parts as seen from the left hand in Fig. 7, the outline of the frame-work of the head being shown by broken lines. Fig. 10 is a side view, and Fig. 11 an edge view, of the index-plate. Figs. 12 and 13 are similar views of the ratchet-wheel for turning the index-plate and spindle. Figs. 14, 15, 16, and 17 are similar views of the pawl-plate and the pinion-plate, respectively. Figs. 18, 19, and 20 are views similar to Fig. 9, illustrative of the operation of the index-plate and accessory parts used when four rifle-grooves are to be cut in a barrel. Figs. 21, 22, and 23 are three similar views illustrative of the operation of the index-plate and accessory parts when constructed and arranged for making six grooves in the gun-barrel. Fig. 24 is a view of the rifling-rod drawn to a small scale. Figs. 25, 26, and 27 are views, drawn on a scale about full or natural size, of a portion of the rifling-rod, shown partially in section, for illustrating the method of feeding out the rifling-cutters. Fig. 28 is a view of the rear end of the rifling-rod. Fig. 29 is a plan view of one of the cutters. Fig. 30 is a front end view of the spindle-socket for holding the rifling-rod. Fig. 31 is a plan view of a portion of the bed of the machine, showing the feed mechanism in position thereon. Fig. 32 is an end view, partially in section, of the feed mechanism, as seen from the left hand in Fig. 1, and showing also a portion of the bed in section. Fig. 33 is a side view of the feed-ratchet and the feed-screw, the ratchet being shown in section. Fig. 34 is a side view of the oil-pump with cover thereof removed. Fig. 35 is an end view of the lock-nut and accessory parts for holding the barrel.

Similar characters designate like parts in all the figures.

The main frame or bed of the machine, which is designated in a general way by the letter B, is somewhat similar in its general proportions to the beds of ordinary "engine-lathes," being composed of the two vertical side walls *c* and *d*, connected at the ends and in some parts of its length by the floor *f*, and being flanged at the base and top of the side walls. The top flanges *e* and *g* form a table whereon to assemble some of the details, and the inner edges of said flanges form the ways 61 and 62 whereon to clamp the barrel-carrying head and the feed mechanism and whereon the carriage is fitted to slide.

In the general views, Figs. 1 and 2, owing to the small scale on which the same are drawn, some of the mechanisms are designated as a whole by a single letter, the barrel-carrying head being designated by the letter H, the feed mechanism by the letter F, and the carriage by the letter C, each of these mechanisms being more fully described in connection with separate and enlarged views thereof.

The principal operative part of the ma-

chine may be considered as carriage mechanism, (designated in Figs. 1 and 2 by the letter C and shown on an enlarged scale in Figs. 5 and 6.) The carriage proper 60 is fitted to slide on the aforesaid ways 61 and 62, being held thereto by the straps or gibs 63 and 64, said gibs being secured to the under side of the carriage by screws in a well-known manner, as indicated by dotted lines in Fig. 6. The half-nut 59 is fixed by screws to the under side of said carriage 60, as indicated in said figures, and is adapted to mesh with the thread of the carriage-driving screw 11, which screw is supported in bearings 13, Fig. 3, and 13′, Fig. 8, on the frame of the machine. When said driving-screw is revolved in one direction, it traverses the carriage toward the left hand in Figs. 1, 2, 7, and 8, and when reversed to run in the opposite direction it traverses said carriage toward the right hand in said figures. The driving mechanism for actuating said screw is shown in the general views, Figs. 1 and 2, and on an enlarged scale in Figs. 3 and 4, and will next be described in detail. At the right hand or rear end of the carriage-driving screw 11 said screw has fixed thereto a gear 10, which may be fastened in place by an ordinary shaft-key (not shown) and the nut 12 in a well-known manner. The driving-shaft 5 is located below the screw-shaft 11, its inner end being carried in the bearings 6, (see Fig. 4,) formed in the frame B, and its outer end in the bearing 7 of the yoke or driving-shaft frame K. Said driving-shaft has fixed thereon the driving-gear 9, which meshes with and drives the aforesaid gear 10 of the screw-shaft. For actuating the shaft 5 said shaft is provided with a set of driving-pulleys consisting of the fixed pulley 3 and the loose pulleys 22 and 24, carried on the shaft at the inner and outer sides, respectively, of said fixed pulley.

Power is supplied to the driving-shaft 5 from a main shaft (not shown) by means of the two belts 2 and 4, one of which is an "open" belt and the other a "crossed" belt, and which are guided to run on the said loose pulleys 22 and 24, respectively, when the machine is idle. When the carriage C is required to be driven in one direction, one of said belts is shifted onto the fixed pulley 3, and when said carriage is required to be reversely operated the other of said belts is shifted onto said fixed pulley. As a means for operating said belts, a belt-shifting mechanism is provided, which in its preferred form is constructed and arranged as follows:

The position of the shipper mechanisms when the machine is at rest is shown in Figs. 3 and 4. The screw 11 being right-handed, and the belts 2 and 4 being run in the directions of the arrows shown thereon, the belt 4 will be the driving-belt for running the carriage C forward or toward the left hand, while the belt 2 will be the returning-belt for drawing back the carriage toward the right hand. Of course the loose pulleys 22 and 24 revolve in the direction of the respective belts thereon. A shipper-rod 23 is carried in suitable bearings, as 25, fixed on the main bed. (See Figs. 1 and 2.) As a means for operating this rod by hand, it has rack-teeth 26, engaging the teeth cut in the inner segmental end of the shipper-handle 27, which is pivoted at 28 to a bracket 29, that is fixed to the bed B. At its right-hand end the shipper-rod has a rack 30, (which may be connected thereto by means of the nut 31,) which rack is fitted to slide in the rack-box 32, and has rack-teeth formed in one side thereof to engage the teeth of the shipper-pinion 33.

In Fig. 3 the covers of the rack-box and of the shipper-cam box are removed to more clearly show the disposition of the various parts. In Fig. 4 said covers are shown secured in place. Said shipper-pinion 33 is carried by the shipper-pinion shaft or stud 34, to which it is or may be fixed by a key, (not shown,) said shaft being fitted to freely turn in a lower bearing at 35 in the rack-box 32 and in an upper bearing at 36 in the cover 37 of said rack-box. A segment 38, designated as the shipper-segment, is also carried by the shaft 34, and is fixed thereto by means of a key. (Not shown.) The teeth of said segment engage rack-teeth that are formed in one side of the shipper-cam 39, as more clearly shown in Fig. 3. Said shipper-cam 39 is fitted to slide in the shipper-cam box 40, which is fixed on the bed of the machine at the right-hand end thereof. Said cam has two cam-grooves 41 and 42, wherein engage, respectively, the shipper-cam pins 43 and 44 of the respective shipper-rods 45 and 50, which are fitted to slide in bearings formed therefor in the cam-box 40, and are provided with the shippers 46 and 51, that are clamped to the rods by the clamp-screws 47 and 52, respectively. For preventing rotation in their bearings of said shipper-rods 45 and 50 their respective pins 43 and 44 pass through slots 48 and 49, respectively, in the bottom of the cam-box 40. As shown in Figs. 3 and 4, the shipper 46 engages the belt 2 and the shipper 51 the belt 4. The organization of this belt-shipping mechanism is such, as will be seen from Figs. 1 and 3, that when the carriage C moves toward the right hand and strikes the stop 111, fixed on said rod 23, it acts through said rod and the connecting-gearing and the cam 39 to first shift the belt 2 from the pulley 3 onto the loose pulley 22 and immediately thereafter (by reason of the form and arrangement of the grooves 41 and 42) to shift the belt 4 from the loose pulley 24 onto the pulley 3, thus reversing the motion of the screw-shaft 11 and of the carriage C. When the carriage has run in the opposite direction sufficiently far, it strikes the similar stop 113, and thus reversely operates the rod 23 to reshift the belts to again reverse the motion of the carriage. The stops 111 and 113 are of course adjustable lengthwise of the rod 23. The bed 60 has formed there-

on or fixed thereto the lugs or ears 110 and 112, the former to engage the adjustable shipper-rod stops 111 and 113 and the latter to engage the indexing-cam-rod stops 114 and 115. (See Figs. 1, 2, and 6.)

The carriage-actuating screw 11 is in practice threaded only a portion of its length, the remaining portion being continued of reduced diameter to connect with the devices for actuating said screw-shaft by hand. This arrangement is shown in Figs. 8 and 9. On the left-hand end of said shaft 11 and adjacent to the bearing 13′ there is a miter-gear 14 (fixed to said screw-shaft by the pin 15 or otherwise) for meshing with the miter-gear 16, which is shown in dotted lines in Fig. 8 and in section in Fig. 9. Said gear 16 is suitably fixed to the inner end of the shaft 17, as illustrated in Fig. 9, wherein the said gear 14 is shown in dotted lines. Said crank-shaft 17 is or may be carried in a bushing 19, which is fitted into a bore in the bed B and secured by screws, as 20. By means of this gearing and a hand-crank applied to the squared head 21 of the shaft 17 the carriage-screw 11 may be readily revolved by hand to bring the carriage to an exact position when adjusting the machine ready for using.

To prevent any undue deflection of the screw-shaft 11, one or more shaft-bearings 18 are fixed to the bed B under said shaft by screws, as shown in Figs. 1 and 6. Said boxes are of course fitted to the outside diameter of the threaded part of the said screw-shaft.

The carriage mechanism C in the preferred form thereof shown in the drawings is constructed and arranged as follows: The carriage-frame 60 is fitted to slide on the ways or guides 61 and 62 of the main bed B, and is provided, as hereinbefore mentioned, with the gibs 63 and 64 for holding the carriage to its ways. The two uprights or heads 65 and 66 on the bed 60 are provided with removable bearings, as 67 and 68, held in place by the usual caps, as 69 and 70, for the rifling-spindle 71. (See Fig. 5.) Two pinions 72 and 73 are fitted to said spindle, being fixed thereto by shaft-keys. A collar or flange 74 and the nut 75 hold the spindle and the pinions thereon in place longitudinally. Said pinions 72 and 73 engage a rack that is preferably made in two parts for the purpose of adjustment to prevent backlash or play. The part 76 of said rack is fixed to the rack-slide 77 by screws, as 78, and the teeth thereof mesh with the teeth of the pinion 72. The part 79 of said rack is closely fitted to slide in said slide 77 and is adjusted longitudinally of the part 76 by means of a screw (not shown) in a well-known manner. A bracket or rack carrying frame 80 is secured to the carriage-frame 60 by screws, as shown, and carries said rack-slide 77, said bracket being supplied with a gib 81 for holding the rack-slide in place. The rack-slide 77 is bored to receive a stud 82, which is also fitted to turn closely in the traverse-bar slide or block 83, thus pivotally connecting said slides. The slide 83 has usually a loose part or gib 84, (shown in end view in Fig. 6,) provided with a screw 85 for adjusting the said slide in a well-known manner to maintain a close fit between the ways 86 of the traverse-bar 87. The said traverse-bar is pivotally supported on the stud 88, which is fixed by a nut 89 in the traverse-bar bracket 90. Said bar is provided for the purpose of regulating the degree of the taper or "twist" of the rifle-grooves being formed in the gun-barrel, and is therefore made adjustable. To this end two brackets or segments 91 and 92 are suitably fixed to the main bed by screws, as shown in the general views, Figs. 1 and 2, and have T-shaped grooves, as 93 and 94, for receiving the T-heads of the clamp-bolts 95 and 96, which bolts are provided with nuts, as shown, to clamp the traverse-bar 87 in any required position. A backward and forward movement being imparted to the carriage by means of the hereinbefore-described screw-shaft and driving mechanism, and the bar 87 being set inclined, as indicated in Fig. 1, said bar traverses the carriage-slide 77 to and fro crosswise of the machine during the carriage movement.

The carriage-spindle 71 is fitted to carry the rifling-rod as follows, reference being had especially to Fig. 5 and to Figs. 24 to 30, inclusive: The rifling-rod is designated in a general way by 100, and has a shank 102, Figs. 24 and 28, fitting into the bore 101 of said spindle. Said shank has formed thereon arms or lugs 103, which fit into the corresponding notches 104, that are formed in the front end of the spindle 71. (See Figs. 24, 28, and 30.) The shank of the rod 100 having been placed in the bore 101 of the spindle 71, with the arms 103 of said shank fitting into the notches 104, the lock-nut 105 is screwed onto the spindle 71, thereby forcing the shank 102 tightly into the socket 101. The check-nut 106, Fig. 24, is then screwed up against the said lock-nut, thus securely holding the rifling-rod in place. The lock-nut 105 usually has notches 107, Fig. 5, formed in the front thereof to allow of the free passage of the arms 103 of the rifling-rod shank 102. To remove the rifling-rod from the spindle, the check-nut 106 is first loosened and then the lock-nut 105 turned back until the shank 102 is loosened and the notches 107 stand in alignment with the arms 103, when the rod may be removed, said arms passing through said notches.

Figs. 25 to 27, inclusive, illustrate the mode of carrying the rifling-cutters in the rifling-rod and the method of feeding out the said tools or cutters. The cutters 108, usually two in number, as shown in the drawings, are inserted in mortises formed in the rod 100. Said rod is bored for a portion of its length to receive the feed-pin or wedge 109, which is flattened and tapered for a portion of its length on two sides thereof to form a thin wedge, by means of which the cutters are forced out. When the machine is pre-

pared for use, said wedge or feed-pin is drawn out, as in Fig. 25, to allow the cutters 108 108 to pass freely through the gun-barrel. At the left-hand end of the machine there is a feed-screw 212, which is turned (by means hereinafter described) toward the right hand a small distance at each stroke of the rod 100. When the rod approaches the feed-screw, as in Fig. 25, the pin 109 strikes the face 212′ of said screw, as in Fig. 26, the wedge being thus driven farther in between the cutters 108 108, as indicated by the lines *a b*, which lines are nearest together in Fig. 25, farther apart in Fig. 26, and still farther apart in Fig. 27, where two feeding operations are supposed to have been performed. The cutters 108 are or may be of the usual description, being shown in plan view in Fig. 29, and each having several inclined cutting-teeth, as 99, adapted to form the required rifle-grooves by successive cuts.

The barrel-carrying mechanism, which is designated by H in Figs. 1 and 2, is more fully shown in Figs. 7 and 8, while some details are further shown in Figs. 9 to 23, inclusive. This division of the machine has a supplemental bed 120, which rests on the ways 61 and 62 of the main bed and is fixed thereto by screws, as shown in Fig. 7. A part of said bed 120 (designated by 121, Fig. 9) supports the indexing-cam box 122, which, with its cover 123, is or may be screwed to said part 121 by screws, as shown. The indexing-cam 124 is fitted to slide in the said box 122 and has fixed to one end thereof the cam-rod 125, which rod is fitted to slide in bearings 126 and 127, that are fixed to the main bed B, as shown in Fig. 1. Said cam 124 has a cam-groove 128 formed therein. In this groove works the cam-pin 129, that is fixed in the indexing-rack segment 130, which is pivoted at 131 in an opening or mortise 132, formed in the said part 121 to receive said segmental gear, together with the rack 133, with which said segment meshes. Two bearing uprights 135 and 136 rise from the bed 120, and two spindle-bearings 137 and 138 are fitted in said uprights, respectively, being held in place by the usual caps 139 and 140. The tubular barrel-carrying spindle 141 is journaled in said bearings and is held in place longitudinally by its flanges 142 and 143, that are formed on said spindle on either side of the box 138. For holding the barrel G to be rifled said spindle is provided at its front end with a lock-nut 185, fitting a screw-thread formed on the spindle after the manner of holding ordinary lathe-chucks. A bushing 180 is bored to receive the enlarged end or breech 181 of the barrel G, and a nut 182 is bored to fit the part 183 of said barrel and to screw into the said bushing 180, thus firmly securing said bushing to the breech of the barrel. The bushing 180 has formed on the front end thereof the lugs or projections 184 to fit corresponding notches formed in the spindle 141, similar to the notches 104 in the rod-carrying spindle 71. The lock-nut 185 is screwed onto the spindle to engage the front side of said projections 184, and thus hold the above-described parts firmly in place. Notches, as 186, are formed in the lock-nut, so that the barrel G, with the bushing 180 fixed thereon, may be removed from the spindle 141 without entirely removing the said lock-nut in a manner essentially the same as above described for removing the rifling-rod from its spindle. A collet or thimble 187, whose outer end 188 is bored to fit the taper of the barrel G, and which is preferably cylindrical in form, is fitted to slide closely in the bore of the spindle 141. It is usually split in one or more places, as at 189, for the purpose of providing a slight degree of elasticity. After the barrel is fixed in the spindle the collet 187 is slid into the spindle 141 until the end 188 of the collet "brings up" firmly on the tapered part of the barrel, as indicated in Fig. 8, thereby accurately centering the same relatively to the spindle.

For intermittently revolving the spindle 141 and the barrel spindle-actuating devices are provided as follows: A pinion 144 is fitted to turn freely on the spindle, the teeth thereof meshing with the teeth of a rack 133, which is fitted to slide on and crosswise of the carriage. A disk 145 is fixed to the hub 146 of said pinion by suitable means, as key 147. The plate 145 carries a pawl-plate 148, which is adjustably fixed thereon or thereto by a stud 116 and nut 118, said plate 148 having a series of holes 156, 157, and 158 therefor. Said pawl-plate carries pivotally supported thereon at 149 (see Figs. 9, 14, and 15) an index or cam pawl 150 and at 151 a ratchet-pawl 152. A stop-pin 153 is fixed in the plate 148 to limit the movement of the pawl 150, as best shown in Fig. 14. A spring 154 (shown in dotted lines in Fig. 9) may be provided to actuate the said pawls. By shifting the bolt 116 from one to another of the holes 156, 157, and 158 the position of the plates 145 and 148 may be adjusted relative to each other to suit different kinds of rifling.

For firmly retaining the spindle 141 in its several positions while making the cuts it is furnished with an index-plate 159, which is shown fixed thereto by a key 160. The spindle-actuating ratchet-wheel 161 is fitted onto the hub 162 of the said index-plate, being usually fixed thereto by a key 163. As is best shown in Figs. 10 and 11, the said index-plate or cam-plate 159 has formed thereon or fixed thereto two similarly-shaped cams 164 and 165, which I denominate the "feed-cams," and which operate the feed mechanism in a manner hereinafter fully described through a lever 166, that is carried by a stud 167, fixed in the upright 136 of the bed 120. (See Figs. 7 and 9.) The cap 140 has formed integral therewith a bracket 168, in which is fitted to slide vertically the lock-bolt 169 for locking the index-plate. Said bracket is furnished with a wedge-shaped gib, as 170, Fig. 7,

for taking up the wear of the bolt, which bolt is provided with a bolt-actuating pin 171. The bracket 168 has an opening formed therein, in which are inserted a spring 172 and a pin or bolt 173, that operate through the pin 171 to hold the point 174 of the lock-bolt 169 normally in engagement with one of the index-notches 179 of the index-plate 159, as is best shown in Fig. 8. On the forward movement of the disk 148 the cam end 150′ of the pawl 150 first lifts the bolt 169 (through the pin 171 thereof) out of engagement with the index-notch, as 179, and next the pawl 152 engages one of the teeth of the ratchet 161, thus turning forward the spindle 141, together with the several parts carried thereby, until the next index-notch, as 179′, comes to the said lock-bolt. During the early part of that forward movement the cam 150′ passes from under said pin 171, and thereby allows the spring 172 to throw down the bolt onto the periphery of the index-plate in readiness to engage the next approaching index-notch, as 179′, Figs. 9 and 10. These several successive operations are illustrated in Figs. 18, 19, and 20, respectively. In Fig. 18 the pawl 150 is carried forward sufficiently far to have lifted the bolt 169 out of engagement with the notch 179. In Fig. 19 the index-plate has been turned forward one full space and the bolt has descended again into the notch 179′. Fig. 20 illustrates the return movement of the pawl-carrying plate 148 and shows the lifting-pawl 150, with the cam 150′ thereof, returning over the bolt-pin 171 in a well-known manner, said cam projecting on one side of the arm of the pawl 150 to provide for that return movement.

In Figs. 21, 22, and 23 are shown successive operations of the ratchet mechanism when constructed and arranged for dividing the revolution into six divisions. According to this modification the index-plate 159 has six notches, and the ratchet 161 has a corresponding number of teeth, as indicated by the dotted lines. In this arrangement the ratchet-plate 148 is shifted on the disk 145 until the pin 116 passes through the hole 158, thus setting the ratchet-plate backward (toward the left hand in Figs. 9, 21, 22, and 23) by a distance equal to the difference between one-sixth of a revolution and one-fourth of a revolution, this position being indicated in Fig. 21. In the operation of the machine when thus adjusted the ratchet-plate 148 moves forward nearly one-sixth of a revolution before beginning to turn the ratchet-wheel 161, this movement being begun when the parts are in the position shown in Fig. 22 and completed when the parts reach the position shown in Fig. 23. On the return movement of the ratchet-plate the movement of the pawl 150 is the same as described in connection with the preceding figures. The intermediate pin-hole 157 (see Fig. 16) is for use when the barrel to be rifled is to have five rifle-grooves made therein. By means of this system of adjustment the machine may be adapted for use in the rifling of different kinds of gun-barrels without altering the above-described mechanism for actuating the pinion 144.

The feed mechanism, which is designated by F in Figs. 1 and 2, constitutes a principal feature of my invention, and is most fully shown in Figs. 31 and 32, reference being had also to Figs. 9, 10, and 11, Figs. 18, 19, and 20, and Figs. 24 to 27, inclusive. The supplemental bed-plate 195 is adjustably fixed to the main bed B near the left-hand end thereof and carries the principal parts of the feed mechanism. Said bed-plate 195 is clamped by straps 196 and bolts 197 to the ways 61 and 62 of said main bed. The feed-slide 198 is fitted to slide on the bed-plate 195 longitudinally of said ways 61 62, being held in place by the guides 199 and 200, formed on the bed-plate, and the guide-straps 201 and 202, which are secured to the said guides by screws, as shown in the drawings. Said feed-slide 198 is bored to receive the reduced part 203 of the rod 23, which passes freely through the said slide and whose outer end is supported by a bearing 204 on the bed 195. A slide-retracting spring 205 is carried by the said rod between the slide 198 and said bearing 204. A stop-pin 206, fitting in the slot 207, is provided for the purpose of limiting the sliding movement of the slide 198 due to said spring. The feed-screw carrier 208 is pivotally supported between the arms 191 and 192 of the slide 198 by means of a pivot-pin 209. The feed-screw ratchet 210 has a hub or sleeve 211 journaled in said carrier and screw-threaded to receive the feed-screw 212, which screw, as shown in the drawings, has a left-hand thread. The revolving feed-screw nut is held in place longitudinally of the carrier by a nut or collar, as 213, in the usual manner. The pin-driving feed-screw 212 is usually furnished with stop-nuts 214 and 215 for limiting the working-stroke thereof. A stud 216 is fixed in the carrier 208 and engages the forked end 219 of the arm 217, which arm is fixed to the outer end of the screw 212 by means of a pin 218 for the purpose of preventing the feed-screw from rotating. The purpose for which the feed-screw is carried by the laterally-shiftable carrier 208 is to permit said screw to be thrown out of its normal or working position forward of the rifling-rod, and thus provide for removal of said rod and of the gun-barrel without obstruction. The carrier being pivoted as set forth, it may be swung into the position indicated by dotted lines in Fig. 32. For limiting its downward movement when shifted into its working position said carrier has a stop-arm 237, which is fitted to bear against a lug 236, that is formed on the slide 198. For locking said carrier 208 in its normal position, as shown by solid lines in Fig. 32, a lock-bolt 238 is provided, which is operated by means of a spring (not shown) and with a knob 239, whereby to withdraw the same. This bolt locks the said

carrier in position by engaging under the arm 237, as indicated in dotted lines in Fig. 32. When about to remove the gun-barrel from the barrel-carrying spindle, the feed-screw is first shifted out of its normal position, as set forth, after which the lock-nut 185 may be loosened and the barrel taken out.

On the rod 203 an adjustable stop-collar 240 is secured by a clamp-screw for the purpose of pushing back or "retreating" the slide 198 when the carriage C reaches a certain predetermined point. This important function of the machine is for the purpose of controlling accurately the feeding in of the wedge 109 notwithstanding there may be a variability in the stroke of the carriage C, for, as will be readily understood, the stroke of said carriage is necessarily slightly variable, owing to the well-known variable action of the carriage-driving mechanism, which, though of slight amount, is still sufficient in practice to prevent satisfactory operation of the cutters.

The apparatus for feeding forward the feed-screw 212 comprises actuating mechanism carried on the head H and a reciprocating pawl connected to be operated by said mechanism. The feed-pawl 223 (see Figs. 31 and 32) is pivotally supported at 224 in the upper end of the pawl-slide or plunger 222, which is carried in the bracket 220, which is set on the bed-plate 195 and fixed thereto. A reciprocating movement being given at the proper time to said plunger 222, the pawl 223 is thereby caused to feed forward the ratchet-wheel 210 one or more notches at a time, as may be required. The upper end of the plunger 222 is larger than the lower part thereof, (see Fig. 32,) and a spring 225, contained in the bore of said bracket, bears against the shoulder of the plunger for actuating the pawl to operate said ratchet-wheel 210. By this means, it will be observed, said wheel is forwardly actuated by the force of the spring. For limiting the working-stroke of the pawl said plunger 222 is provided at its lower end with the check-nuts 226 and 227, as will be fully understood from the drawings. The plunger is drawn back by means of the arms 233, which bear against the projecting ends of a pin 235, which passes through slots (not shown) formed in a well-known manner in the sides of the plunger-case 221 and passes through the plunger. Said arms bearing against the forward side of said pin, the downward motion of the arms retracts the plunger, while the upward motion thereof simply permits the forward movement of the plunger without compelling such movement. The rocker-arm 233 is carried by the rock-shaft 228, which is supported at one end in the bearing 230, fixed to the bed B, (see Figs. 1 and 31,) and at the other end in the similar bearing 229, fixed to the bed B adjacent to the frame 120, that carries the hereinbefore-described spindle 141. Said rock-shaft 228 is held in place longitudinally by a collar 232, fixed thereto on one side of the bearing 229, and by an arm 231, fixed thereto on the other side of said bearing, as best shown in Figs. 7 and 9. The arm 231 bears on the outer end of a lever 166, which is pivoted to a stud 167, fixed in the head of frame 120, and whose inner end is shaped to bear against the cams 164 and 165 as these revolve with the spindle 141. As shown in Figs. 9 and 10, the index-plate 159 carries two said cams, which are substantially alike, while the index has four divisions. This arrangement results in operating the feed mechanism once for each two strokes of the carriage C, the barrel being rotated through one of the index-plate divisions for each movement of said carriage. It will be obvious that the lever 166 may be dispensed with, provided the arm 231 be lengthened sufficiently to be operated by said feed-cams 164 and 165. The purpose of said lever is to reverse the motion and to reduce the size of the parts; also, to secure what is deemed in some respects to be a preferable arrangement of the mechanism. When the machine is in operation and the cam 164, for instance, acts upon the lever 166 to turn the rock-shaft 228 to draw back the plunger 222, the pawl 223 passes over the notches of the ratchet-wheel 210, and on the reverse movement of said shaft the spring 225, acting through said plunger and the pawl 223, feeds forward said ratchet. This operation goes on until the check-nut 214 comes against the end of the ratchet-wheel hub, and, since the ratchet-wheel cannot be turned farther, the plunger on being drawn back, as set forth, is retained there by the pawl 223 engaging in the notches of said wheel 210, thus stopping the feeding operation. The arm 233 being, as hereinbefore stated, forward of the pin 235, it cannot act directly to feed said ratchet-wheel. This mechanism furnishes a very convenient and effective means for feeding said wheel and one which is safe in practice, since when the feed-screw reaches its limit the feeding mechanism becomes inoperative.

For oiling the rifling-cutters I use an apparatus which is constructed and arranged as follows: An oil-tank T, a portion of which is shown in dotted lines in Fig. 6, is fixed to the under side of the bed B near the right-hand end thereof. An oil-pump P, of a well-known type, (shown in plan view in Figs. 1 and 3 and in side view, with the cover removed, in Fig. 34,) is fixed to the main bed of the machine. This pump is of the well-known "geared" variety, and consists of the usual pump-frame 245, having a driving-shaft 246 journaled therein, to which is fixed the driving-gear 247, that meshes with and drives the similarly driven gear 248. The gear 248 is carried by a stud 249, which is journaled in the pump-frame, as shown. Said pump is driven by means of a belt (not shown) running on a driving-pulley 250, fixed in the driving-shaft 246. A suitable pipe-connection is had with the oil-tank by means of the ordinary pipes and pipe-joints designated by 251, through

which the oil is drawn from said tank into said pump. The oil is then forced by the said pump-gears through the large conveyer-pipe 252, which is suitably connected to the pump, as shown. A small sliding conveyer-pipe 253 is "telescoped" into the horizontal pipe 252, and from said smaller pipe rise the oil-spouts 254 and 255, said pipes and spouts being supported by the pipe-supporting clamps 256 and 257, respectively, which are adjustably secured to one of the ways of the bed B by clamp-screws, as indicated in the drawings. (See Figs. 1, 2, 3, 4, 7, and 8.)

The general operation of the machine is as follows: In preparing to use the machine the operator shifts the feed-screw out of its normal position, as indicated by dotted lines in Fig. 32. Next the rifle-barrel G is properly placed, as hereinbefore described, in the barrel-carrying spindle 141 of the head H, and the traverse-bar 87 is set at an angle corresponding to the required twist of the rifle-grooves to be made. The rifle-cutters and the feed-pin 109 are properly placed, as indicated in Fig. 25, in the rifling-rod 100, which rod is then properly fixed, as hereinbefore described, in the rod-carrying spindle 71 of the carriage C. The pin-driving feed-screw is now shifted into its working position (shown in solid lines in Fig. 32) and (the pawl 223 being lifted by hand) the ratchet-wheel 210 turned back until said screw is retreated, so that on the first working-stroke of the rod 100 the feed-pin 109 will only come to the face 212′ of said screw without being thereby driven into the rifling-rod. The pawl 223 is then dropped into engagement with the ratchet 210, and the adjusting-nuts 226 and 227 on the plunger 222 are set for limiting the feed-pawl movement to the desired number of ratchet-wheel notches. Next the stop 240 on the rod 203 is set for retreating the feed-slide 198 when the feed-pin 109 comes to the face 212′ of the feed-screw 212, so that, as hereinbefore set forth, any excess of the normal stroke of the carriage will drive back the feed-slide and the feed-screw thereon, so as to prevent overfeeding the rifling-cutters 108 on the contacting of the said pin 109 and the face 212′. The stops 111 and 113 are suitably fixed on the shipper-rod 23 to reverse the motion of the screw-shaft 11 when the carriage reaches the ends of its proper stroke, which stroke is made to correspond with the length of the barrel being rifled; also, the stops 114 and 115 are properly placed on the rod 125 for actuating, as hereinbefore described, (and at the ends of the carriage movement,) the index mechanism for revolving the gun-barrel. The machine being now started up, the carriage C has given thereto, by means of the driving mechanism therefor, a reciprocating movement limited by the position of the aforesaid stops 111 and 113 and at the completion of each forward stroke of the carriage by means of the stops and connecting mechanism described. The spindle 141, carrying the barrel therein, is turned forward through the space of one division of the index-plate 159. The time, however, of said rotating movement may be shifted to the other end of the working-stroke of the carriage by reversing the construction of the groove 128 in the slide 124 (see Fig. 7) in a well-known manner. The feed-cams 164 and 165 being only half the number of the index-plate divisions, the cutters are fed out only at each alternate forward stroke of the carriage, so that said cutters make one cut on their forward stroke and one on their return-stroke, the said two cuts being in successive rifle-grooves. At each forward stroke of the carriage toward the left hand in Figs. 1 and 2 the feed-pin comes, as before stated, to the feed-screw 212, and whenever said screw is advanced toward the right hand said pin will thereby be driven between the rifling-cutters, and these cutters thereby fed outward for taking a deeper cut. The operation of the machine being continued, as here described, until the feed-screw stop-nut 214 is brought against the hub or collar 213, the feeding forward of said feed-screw is thereby, as hereinbefore set forth, stopped, thus finishing the feeding out of the rifling-cutters. This operation being completed, the operator stops the machine by means of the handle 27, whereby he shifts the shipper-rod 23 to bring the belts 2 and 4 onto the loose pulleys 22 and 24, respectively, as indicated in Figs. 3 and 4, and if at that moment the carriage C has not withdrawn the rifling-rod from the barrel G the operator, placing an ordinary crank on the squared stem 21 of the shaft 17, turns the screw-shaft 11 to run the carriage to the desired position. This being done, the feed-screw is shifted out of its normal position, as hereinbefore stated, the lock-nut 185 is loosened, and the barrel G removed, after which another barrel is put in place, the feed-pin 109 withdrawn from its position in Fig. 27 to that shown in Fig. 25, the feed-screw 212 again retreated, and the machine otherwise made ready, as hereinbefore described, for further operation.

In operating the machine the oil-spouts 254 and 255 are set to deliver oil to the cutters as they emerge at either end of the rifle-barrel, so that for each cut the rifling-cutters are first thoroughly lubricated. During the operation of the machine the carriage C traverses to and fro through nearly the same stroke each time it goes forward; but, as before mentioned, said stroke is unavoidably slightly variable. This variation is fully overcome, so far as to avoid defective cutter-feeding due thereto, by means of the rod operated from said carriage and carrying a stop, as 240, set for retreating the feed-screw and its carrier when the carriage goes beyond its normal movement. By means of this retreating feed-screw the highest efficiency and perfec-

tion of operation is readily attainable and the most serious drawbacks of the old kind of rifling-machines effectually overcome.

By means of my improved mechanism for rifling-machines I am enabled to use for operating the rifling-rod a driving mechanism, substantially as herein described, having a reversible screw-shaft for imparting the reciprocating movement to the carriage, whereby a uniform velocity of movement is obtained throughout the stroke of the rifling-rod, thereby securing uniformity of cutting action throughout the length of the rifling-groove. It is well known to men skilled in this art that a variable cutting speed also varies the action of the cutters, so that it is difficult to produce perfect work when the carriage is driven (as it generally is in the old kinds of rifling-machines) by a crank and connecting-rod, it being remembered, of course, that the crank and connecting-rod for driving the rifling-machine carriage have heretofore been used chiefly on account of the limitations of the old kinds of pin-driving feed mechanism.

It will of course be understood that many of the minor details of construction shown in the drawings are old and well known, and are therefore not to be regarded as limitations of my invention, being adopted for use in my improved rifling-machine because the value thereof as machine elements is established by practice. Of this nature is the apparatus, for instance, intermediate to the rod 23 and to the shipper-rods 45 and 50, this shipper-actuated mechanism being substantially the same as that heretofore used for reversing the movement of metal-planers and machines of like character.

Having thus described my invention, I claim—

1. In a rifling-machine, the combination, with the barrel-carrying spindle and with the carriage having a rifling-rod carrying rifling-cutters and a feed-pin for said cutters, of feed mechanism located for driving said pin and constructed and connected to be retreated on the movement of the carriage beyond its normal forward stroke.

2. In a rifling-machine, the combination, with the reciprocating rifling-rod having cutters and a feed-pin, substantially as described, of a pin-driving feed mechanism having a feed-slide connected to be retreated on the movement of the rifling-rod beyond its normal forward stroke.

3. In a rifling-machine, the combination, with the reciprocating rifling-rod having cutters and a feed-pin, substantially as described, of a pin-driving feed-screw carried by a carrier constructed and connected to be retreated on the movement of the rifling-rod beyond its normal forward stroke.

4. In a rifling-machine, the combination, with the reciprocating rifling-rod having a feed-pin projecting from the forward end thereof, of the feed-screw carried by a slide movable longitudinally of the machine, said slide being connected, substantially as described, to be retreated on the movement of the rifling-rod beyond its normal forward stroke.

5. In a rifling-machine, the combination, with the slide carrying the pin-driving feed-screw, of a stop limiting the movement of said slide toward the rifling-rod, and a spring normally holding the slide to said stop, whereby the slide is permitted to retreat, as set forth, and the feed-pin is actuated by said spring through the slide and feed-screw.

6. In a rifling-machine, the combination, with the feed-slide, of the feed-screw carrier shiftable thereon and carrying the feed-screw, and means for locking and unlocking said carrier, whereby the feed-screw may be shifted out of its working position, substantially as set forth.

7. In a rifling-machine, the combination, with the carriage having a rifling-rod, substantially as described, provided with a feed-pin, of means for carrying the rifle-barrel, the feed-slide carrying feed mechanism, substantially as described, and a rod carrying adjustable stops intermediate to the carriage and feed-slide, whereby the feed-slide may be retreated on the movement of the carriage beyond its normal forward stroke.

8. In a rifling-machine, the combination, with the feed-slide carrying a feed-screw, of means, substantially as described, for actuating said feed slide to retreat the feed-screw, a ratchet-wheel operating the feed-screw, the pawl located for engaging the ratchet-wheel during the retreating movement of the feed-screw, and means for actuating said pawl.

9. In a rifling-machine, the combination, in the feed apparatus thereof, of a supplementary bed adjustable longitudinally of the machine, the feed-slide supported on said bed for retreating movement, a feed-screw carried on said slide, and a feed-screw-actuating pawl carried by pawl-actuating means, substantially as described, supported on said bed.

10. In a rifling-machine, the combination, with the barrel-carrying spindle, of means, substantially as described, for intermittently rotating said spindle, the carriage and the cutter-provided rifling-rod carried thereby, said rod having a feed-pin for feeding out the cutters, a feed-screw located in the path of said feed-pin, a ratchet and pawl for engaging the feed-screw, one or more feed-cams carried on the barrel-carrying spindle, and connections actuating the feed-screw ratchet from said cams, whereby the feed-screw is advanced toward the carriage on the rotation of the spindle.

11. In a rifling-machine, the combination, with a barrel-carrying spindle, of a disk arranged to have a rotary reciprocating movement on said spindle, an index-plate fixed on the spindle, a ratchet-wheel fixed on the spindle, a lock-bolt for said plate, means for rotating said disk through a fixed arc, and a ratchet-

plate carrying one pawl for revolving said spindle and a cam-pawl for lifting said bolt, said cam-plate being constructed for attachment to the rotary reciprocating disk in successive positions corresponding to different numbers of divisions in the index-plate.

12. In a rifling-machine, the combination, with the barrel-carrying spindle, of the pinion 144 and means for imparting a rotary reciprocating motion to the said pinion through a fixed arc, the ratchet-wheel and index-plate fixed on said spindle, the lock-bolt engaging the index-plate, a spring normally holding the lock-bolt in engagement with the index-plate, and pawls, substantially as described, adjustably fixed on said pinion and arranged to first lift the lock-bolt and then engage the ratchet-wheel for turning the spindle.

13. In a rifling-machine, the combination, with the barrel-carrying spindle and with means, substantially as described, for locking the barrel in said spindle, the bore of the spindle being larger than the diameter of the barrel, of the thimble 187, fitted to slide in the spindle and to engage the barrel by the tapering part thereof, as set forth.

14. In a rifling-machine, the combination, with the barrel-carrying spindle and with the pinion adapted to run thereon and provided with spindle-actuating pawls, of the index-plate and ratchet-wheel fixed on the spindle and adapted, substantially as described, to be actuated by said pawls, the rack 133, the cam-slide 124, arranged to slide lengthwise of the spindle and crosswise of the rack, said slide having therein a cam-groove, and means, substantially as described, for actuating said pinion through said rack from said cam-groove.

15. In a rifling-machine, the combination, with the carriage having the rifling-rod provided with cutters and a feed-pin, of the barrel-carrying spindle located forward of the carriage and having means for holding the barrel to be rifled, the cam-slide connected, substantially as described, for intermittently actuating said spindle, connections actuating said cam-slide from the carriage as the carriage approaches the ends of its stroke, feed-cams carried on the spindle, feed apparatus located forward of the barrel-carrying spindle in position for contacting with the feed-pin at the forward end of the carriage movement, a ratchet and pawl for operating the feed-screw toward the carriage, and the rock-shaft connected, substantially as described, to be actuated from said feed-cams on the spindle and to actuate said pawl, whereby the feed-screw is advanced by connections from the carriage through the barrel-carrying mechanism.

16. In a rifling-machine, the combination, with a main bed and with driving mechanism at one end thereof, of the carriage actuated from said mechanism to have a reciprocating movement on the main bed, barrel-carrying mechanism forward of the carriage, means for rotating the barrel-carrying spindle of said mechanism through connections with the carriage, feed mechanism forward of the barrel-carrying mechanism and having the feed-screw supported on a retreating slide, and a reciprocating rod connected to be actuated from the carriage and to actuate the reversing apparatus of the driving mechanism, said rod having a stop located thereon to retreat the feed-slide when the carriage goes beyond its normal forward stroke.

17. In a rifling-machine, the combination, with a feed-screw, substantially as described, and with a ratchet-wheel arranged for advancing said screw, of the adjustable stop on the screw for limiting its advancing movement by engaging said ratchet-wheel, the plunger having a pawl engaging said ratchet-wheel, a spring arranged to actuate the plunger for turning said wheel, said plunger being provided with a stop for limiting its forward movement, and a reciprocating arm connected and arranged to retract the plunger.

CHAS. W. SPONSEL.

Witnesses:
FRANCIS H. RICHARDS,
HENRY L. RECKARD.