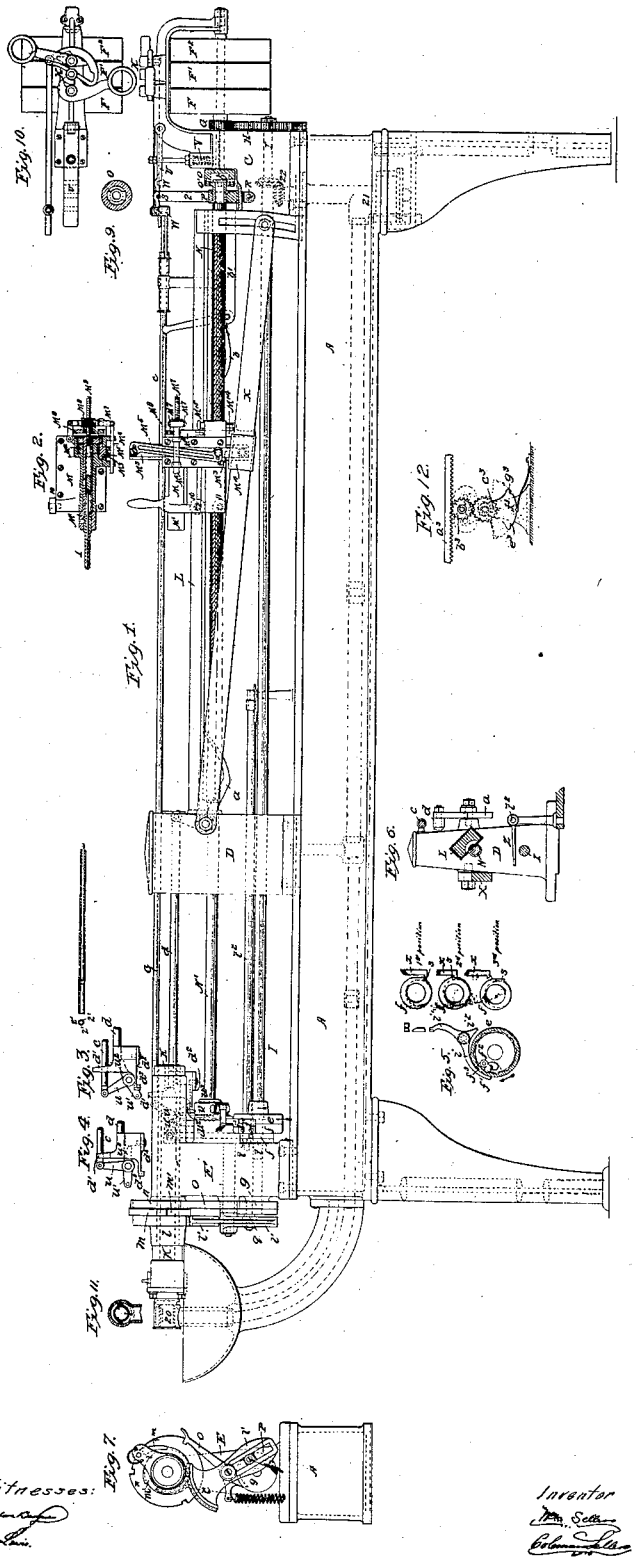
W. & C. SELLERS.

MACHINE FOR RIFLING GUN BARRELS.

No. 46,714. Patented Mar. 7, 1865.



Witnesses:

Inventor
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UNITED STATES PATENT OFFICE.

WILLIAM SELLERS AND COLEMAN SELLERS, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNORS TO WILLIAM SELLERS & CO.

IMPROVEMENT IN MACHINES FOR RIFLING GUN-BARRELS.

Specification forming part of Letters Patent No. **46,714**, dated March 7, 1865.

To all whom it may concern:

Be it known that we, WILLIAM SELLERS and COLEMAN SELLERS, of the city of Philadelphia, in the State of Pennsylvania, have invented certain Improvements in Machines for Rifling Gun-Barrels; and we do hereby declare the following to be a full and exact description thereof.

The objects of our invention are, first, to arrange the various motions required in a machine for rifling gun-barrels in series dependent upon each other, so that the completion of motion in one of the series shall put the next into operation, which, on its termination, shall start the third, and so on until the whole are completed, and that the starting of each motion or series of motions shall be dependent upon the absolute completion of the preceding motion, so that, should any accident prevent the completion of one motion of the series, the remaining motions will not be operated until the impediment shall be removed; second, to arrange the driving machinery which operates the rifling-rod so that, should the cut prove too heavy for the length of the rod, the driving-motions will be disengaged and the machine will stop; and, third, to provide a certain means of clearing the cutters of chips and to furnish them with proper lubrication when at work.

To explain the method of carrying out the objects of our invention to enable any competent mechanic to build a machine on the principles, and to elucidate the theory of the methods proposed, we have hereto annexed drawings, which make part of this specification, in which—

Figure 1 represents a side elevation of a rifling-machine; Fig. 2, sectional plan of carriage; Figs. 3, 4, and 5, positions of the shifting-motion at stand E; Fig. 6, end elevation of stand D; Fig. 7, end elevation of stand E, showing barrel-turning machinery; Fig. 8, rifling-rod; Fig. 9, sectional view, showing clutch-box O; Fig. 10, plan of belt-shifter; Fig. 11, sectional view of washing-box; Fig. 12, sketch of an equivalent plan.

Similar letters on each relate to similar parts.

Referring to these drawings, A, Fig. 1, is the bed of the machine. Upon this bed are placed three principal uprights, C, D, and E, to carry the working parts of the machine. The first of these, C, carries the main driving machinery and supports one end of the slide-bar, upon which travels the rifling-carriage. The second one, D, sustains the other end of this bar, and contains part of the washing machinery for the cutters. The third one, E, has the barrel-holder and all the machinery for turning the barrel attached to it. At the upright C are three pulleys, F, F′, and F″. Of these the middle one, F′, is fast to the shaft, and the two outside ones, F and F″, are loose on the same shaft. To these loose pulleys power is conveyed from a counter-shaft by an open and a cross belt, passing through the arms of the belt-shifter motion K, this being the arrangement of belt-shifter as patented by Wm. Sellers December 16, 1862. The belt-shifter is so arranged that both belts can run simultaneously on the two loose pulleys, and either one can be shifted onto the fast pulley, thus running the fast pulley either forward or backward. The belt on F, however, is so arranged that the shifter can never drive it entirely off of F onto F′, but will always allow it to lap a little ways onto the pulley F, so that F will never cease to run in the same direction during the operations of the machinery. Fast to the hub of pulley F is a pinion, G, gearing into which is the spur-wheel H on the shaft I.

Thus the continuous motion of the pulley F is imparted to the shaft I. The shaft I extends through the stands C and D to E, and there, at proper intervals, can be made to operate some of the required series of motions. Upon the slide-bar L is the rifling-rod carriage M. The carriage M is driven by a screw, N, parallel with the bar L, and on a line with the axis of the driving-pulleys F F′ F″. The screw N receives its motion from the driving-pulley F′ through a clutch, O, of peculiar construction. This clutch consists of a cylindrical box attached to the pulley-shaft. This box has a face-plate, O^1, bolted to it. In the center of the plate O^1 is an oblong opening. The screw N has a T-piece, O^2, on its end, which fits the opening in the plate O^1, and is of the same thickness as the plate. When this T-piece or carrier O^2 coincides with the plate O^1 it will be driven by it in the manner of a clutch; but if it be pushed into the interior of the box O,

or pulled entirely out of it, the connection between the two will cease; hence it is a clutch so arranged as to be thrown out of gear by a motion in line of its axis in either direction.

The screw N has its bearings in the uprights C and D, and an extension of it, N′, continues as far as the stand E. The screw N is not held endwise by collars or shoulders in any of these stands, but is capable of sliding back or forth to a limited extent. It is, however, when at work, held in position by a ring, P, between collars on the screw N, this ring being attached to the two levers, Q Q. The levers Q have their fulcrums on the stand C at R, and are united at their upper end by a knife-edge piece, S. This knife-edge fits exactly a notch in the latch U, to which latch is adapted an adjustable spring, V, which tends to hold it down firmly upon the knife-edge. The latch U is also provided with two notches, W W′. If the latch U be raised up by hand, the levers Q may be vibrated back or forth so as to unclutch the screw from the driving-pulley by forcing the carrier into the box O or pulling it out of it, and it can be held in either of these positions by the notches W W′; but when the knife-edge S is in the center notch, as is shown in the drawing, the clutch O is in gear with the screw. The pressure of the latch U upon the knife-edge must be so adjusted as to hold it in gear during the ordinary working of the machine; but under any undue strain it will raise the latch and force the lever Q into either of the notches W W, and thus uncouple the screw at O. If the knife-edge be made with its sides beveled equally in either direction, an equal strain in either direction on the screw will force it out of gear; but if its sides be made steeper on one side than on the other, it may be made to resist a more severe strain in one direction than in the other; hence, if the rifling-rod will bear more strain under tensions than under thrusts, the knife-edge may be adjusted so as to allow for this difference. This is one of the important features of our invention.

The carriage M, when at work, is moved back and forth by the screw N, which screw receives its motion from the pulley F′; but if the carriage M meets with a greater resistance than the rifling-rod will bear with safety, the strain acts directly upon the latch, the screw is disengaged at O, and stops. The motion of the screw at either end of the stroke is reversed by levers *a* and *b*. The latter, *b*, is attached to an adjustable bar, b^1, so as to regulate the length of the stroke. The arm b^2 of lever *b* acts on the belt-shifter rod *c*, which extends the whole length of the machine.

When the carriage M approaches the lever *b*, two rollers, 10 and 11, on carriage M move the lever and shift the belts, so as to reverse the motion of the screw, while at the end of the stroke the same rollers operate the lever *a*, and this lever, through the rod *d*, shifts the driving-belt onto the loose pulley, but does not move far enough to throw on the opposite belt. Thus it stops the motion of the screw, but does not reverse its motion, as is the case at the other end of the stroke. Sliding on the end N^1 of the screw N is a disk-brake, u^3, covered with leather. The brake is worked by a lever, *v*, and when the rod *d* is forced forward by the lever *a* a fork, d^1, on the end of it operates the belt-shifter rod to throw off the driving-belt, as has been stated, and a stop, d^2, presses against the end of lever *v*, and thus forces the brake-disk against the stand E, suddenly stopping the screw.

With this brake tightened, and both belts off the driving-pulley, it is evident that the screw cannot be again started except by the action of some motion outside of that just described. This, then, is the first of a series of motions depending upon their own completion to put in operation the subsequent motions.

As we have before said, the shaft I runs continually in one direction, regardless of the motion of the screw—that it is always driven by the pulley F, whether the belt on F is partially engaged in driving the screw or not. Keyed to the end of the shaft I is a wheel, *e*, provided with internal teeth, forming a ratchet-wheel. (See Fig. 5.) By the side of *e* is a pawl-wheel, *f*, with a journal entirely through the stand E, and carrying a crank-plate, *g*, on its other end. The pawl-wheel *f* is provided with a stop, f^1, on its outside, and a spring-pawl, f^2. This pawl, which is designed to engage in the teeth of the internal ratchet *e*, has a projection, f^3, entirely beyond the outside of *f*. The spring tends always to force the pawl into the teeth, and, as the wheel *e* continually revolves in the direction of the arrow, it would carry with it the pawl-wheel *f*. Hinged to the stand E is an escapement, *i*, one projection of which rests on the pawl-wheel *f*, another, i^1, (see Fig. 5,) extends up toward the end of rod *d*, and the third, i^2, projects down behind the pawl-wheel *f*. In the revolution of the wheel *e*, carrying with it the pawl-wheel *f*, the escapement *i* resting on the circumference of *f*, the tail of the pawl will come in contact with the escapement *i*, and the pawl will be forced out of gear with the teeth in *e* simultaneously with the stop f^1 coming in contact with the escapement and arresting the motions of the wheel *f*. But, should the escapement *i* be raised above the stop f^1, the pawl f^2 will be again driven into the teeth, and *f* will be carried forward with *e*. As the stop f^1 passes under the projection i^2 will force *i* down against the wheel *f*, so that, at the completion of one revolution of the wheel *e*, the wheel *f* will be stopped. Therefore, upon the liberation of the escapement the wheel *f* will make only one revolution and then stop. This is the second step in the series, and is started at the completion of the motion of the carriage M toward the stand D; for, when the lever *a* moves the rod *d*, and thus stops the screw *a*, projection d^3 passes behind the arm i^1 of the escapement, and this starts the revolution of *f*.

This arrangement of the wheel *e* is essen-

tially what was patented by WM. SELLERS, January 21, 1862.

The barrel to be rifled is held in a hollow spindle, K, in stand E. This spindle is provided with a loose segmental wheel, *l*, to which is attached a pawl, *m*. Fast to the spindle K is a ratchet-wheel, *m'*, and a locking-plate, *n*. Both of these have as many notches as there are to be grooves in the rifled barrel. In the present case there are three. Gearing with the segmental wheel *l* is a spur-segment, *F*, provided with a radial slot, *p*, in which works the crank-pin *q* of the crank-wheel *g*. These are so proportioned that one revolution of the crank-wheel will give to the wheel *l* a motion forward and back of a little more than one-third of a revolution. The lock-plate *n* has a latch, *o*, falling into its notches, and the tail of this latch rests on the crank-wheel *g*. The crank-wheel is made in the form of a cam, so adjusted as to lift the latch out of the lock-plate during one-third of its revolution, while during the same one-third of a revolution it is throwing back the pawl *m* behind a new tooth in the wheel *m'*, and during the remaining two-thirds of its revolution the barrel is turned and the locking-catch thrown into a notch at the end of the entire revolution. This is now the first effect of the one revolution given to the wheel *f*, and ends with the stopping of that one revolution, the barrel being turned one-third of a revolution. In this step of the series, however, all motion would cease did not the completion of this motion put into operation some new movement.

To the end of the shifter-rod *c* is jointed a bell-crank, *u*, with three arms at right angles to one another. When the rod C has been moved by the rod *d* one of these arms will stand vertically (to this the rod *c* is attached) and the other two will be horizontal. To one of them, u^1, is attached a vertical rod, *x*, sliding in a box in stand E, and having at its lower end a hook, so placed that when *f* is revolving and has nearly completed its revolution a projection on it at *s* will hook onto it, drag it down, and pass it. In doing so the bell-crank is pulled into the position shown in Fig. 3, and the belt is shifted onto the fast pulley to impart the back motion to the carriage M. At the same time the arm u^2 of the bell-crank lifts the end of rod *d* up, liberating the brake and holding the projection d^3 above the escapement-lever. Then, when the carriage M has passed away from the lever *a* the rod *d* is restored to its normal position, and the end of rod *d* is dragged off from the arm u^2, thus skipping over the escapement without touching it, and falling into position shown in Fig. 1, ready for the repetition of its motions.

Attached to the wheel *f* is a cam-wheel, *t*, and on this rests a lever, t^1. This lever is to work the feed, and is on a shaft, t^2, which extends past the stand D a short distance, and carries at its other end a T-shaped lever, Z. This lever Z is what imparts the feed to the cutters in the rifling-rod, as will be presently shown. The rifling-rod and cutters differ in no respect from those used in the government armories. It consists of a hollow rod, 1, (see Fig. 8,) with openings near one end for the cutters 2 2 2. The cutters are held in by springs, and within the rod 1 is a cone, 3, attached to a rod extending through rod 1 up to the feed-screw of the rifling-carriage M. In the carriage M is a spindle, M^1. To this a rifling-rod is attached, and on it is a pinion, M^2. This pinion is moved by a rack, M^3. Sliding vertically in guides on the side of the carriage M, at the lower end of the sliding rack M^3, is swiveled a box, M^4. This box slides on the twist-bar X. The angle which the twist-bar X makes with the slide-bar L is variable by an adjustment at one end of it in the slot in the head C. As the carriage M travels back and forth on the bar L the twist-bar imparts to the spindle M^1, and consequently to the rifling-rod, the twist wanted in the grooves. Attached to the rack M^3 is an adjustable grooved piece, M^5, in the grooves of which is fitted a block swiveled to the cross-slide M^6. This cross-slide has linked to it two levers, M^7 M^7, which carry a collar, and inside of it is the hub of the ratchet feed-wheel M^8. The hub of this wheel is the rest of the feed-screw M^9, and is what moves the cone 3 in the rifling-rod to adjust the cutters. This cone is dragged back and forth a fixed amount by the slot in the grooved piece M^5 at each stroke of the rifling-rod, and thus produces the variable depth to the rifle-grooves required in some kinds of guns. The collar which carries the ratchet-wheel M^8, not fitting sidewise, will allow some lost motion in this sliding motion of the adjusting-cone, and thus give clearance to the cutters on the back-stroke. The feed is given to the cutters by a pawl, M^{12}, attached to a vertical slide, M^{14}. This slide is forced down by a spring, but its position is adjusted by a screw, M^{15}. This vertical slide is so placed that when the carriage M is at the end of its stroke, and has stopped, it is immediately over the T-shaped lever *z*. The feed is thus given during the time that the carriage is at rest, and as the barrel is being turned by the cam *t* operating the levers t^1 *z*. This, then, is also one of the important features of the invention, as has been stated, in the object aimed at.

The cutters are freed from their chips and proper lubrication insured by means of washing-boxes at both ends of the barrel—one being within the stand D and the other shown at the end of the barrel at 20. They consist of annular cylindrical chambers, (see Fig. 11,) with slots corresponding with the cutters within rifling-rod on the inner sides. Oil under pressure is conveyed to them through pipes on the bed from a pump, 21, driven from the constantly-moving shaft I at 22. As the cutters emerge at either end of the barrel they come in contact with a flood of oil, which, striking the cutters, loosens up the chips and carries them away. The rod, too, passing through the washing-box in the stand D, car-

ries with it a great deal of oil into the barrel, and thus lubricating it ready for the cut.

From the above it will be seen that the theory of operation of a machine built on our plan is in providing a continuous motion of one part of the machine, from which continuous motion the intermittent motions are derived. The separate and distinct motions are put in operation by the completion of some previous motion, and cannot take place unless the previous motion has performed its required function.

In a machine having a main shaft, upon which are certain cams, cranks, or tappets, the continuous motion of such a shaft may be made to operate certain intermittent motions in a certain order or series; but in such a case these motions will not be dependent on each other, but upon the position of the main shaft in regard to its own revolution; and although one or more of these motions may fail to perform their required purpose, as by the sticking of some lever and its refusal to follow some cam, the other motions would continue in their proper time regardless of the non-completion of those which had failed.

In a machine constructed on our plan the case is totally different, and its true theory can only be understood by comparison with such an instance as the above, for with us, the continuous motion puts into operation some one of the necessary movements, and then no other movement can take place until the absolute completion of this one operation, which in turn starts the next one, and so on through the whole series.

We use a screw to drive the rifling-carriage, so as to insure a constant velocity to the cutters in the barrel and to enable the speed of cut to be carried to the utmost that the cutters will stand. By stopping the motion of the screw entirely during the barrel-turning, &c., the rifling-rod is made no longer than is absolutely necessary to reach through the barrel; hence, this principle of stopping the carriage entirely is an important feature of our invention, as it enables us to effect the subsequent movements with a rapidity consistent with the durability of the parts and yet to move the carriage also at a velocity as great as the cutters will stand.

In a rifling-machine driven by a crank the cutters move more rapidly during the middle of their stroke than at the ends, and consequently the number of strokes per minute must be limited to what the cutters will bear during the rapid part of the stroke, while, if the same velocity could be kept up during the whole stroke, (as is the case in our machine,) the number of strokes per minute would be greater.

One of the greatest troubles with rifling-machines has always been the breaking or bending of the rifling-rod from its catching in the barrel, the motion of the machine continuing. In our arrangement this is prevented entirely in the manner specified, the screw always disengaging itself when subjected to too great a strain.

Our method of cleaning cutters from the chips offers peculiar advantages over the old way of brushing, the brushes being cut away by the chips, and the edges of the cutters are very uncertain in their action, while, in our plan, the jets striking the cutters loosen up and carry away the chips, besides insuring the most thorough lubrication to the cutters.

In the above specification we have described certain devices which fulfill the objects of our invention, and have referred to these devices only in explaining the theory upon which it is based; but it must be evident to any intelligent mechanic that these devices may be altered without affecting the theory. Thus the carriage is moved by a screw to accomplish a certain object conveniently, said object being to impart a uniform motion to the rifling-carriage, to be able to regulate the length of the stroke, to provide a means of stopping the motion of the carriage entirely during the barrel-turning, and to provide a means whereby an extra strain on the cutters may be made to stop the machine. If, for instance, we were to attach to the carriage a rack, and to drive this rack back and forth by a pinion, the motion would be a uniform one, capable of being adjusted in length of stroke by a belt-shifter, and it could be stopped at the end of the stroke to admit of the subsequent movements as readily as the screw. That it can also be made to disengage itself under any undue strain can be easily demonstrated.

In Fig. 12 we have shown a rack, a^3, which can be attached to the carriage. Gearing into it is a pinion, b^3. This pinion is driven by another one, c^3, on the pulley-shaft. b^3 is held in a frame, and can vibrate around the wheel c^3. Hence it can be made to drive the rack, or it could be vibrated out of gear with the rack in either direction, as is shown by the dotted lines. To the frame which carries this wheel is attached a segment having notches in it, e^3, f^3, and g^3. Into the center notch a knife-edge latch is fitted, with a spring-pressure to hold it in place. This will measure the force of cut, and an undue strain will pull the segment-notch away from this knife-edge. The pinion b^3 will vibrate out of gear in either direction, so that, whether we use a screw or rack, the theory of operation is the same.

It is also evident that the devices for starting the various motions in the series, and the machinery for performing those motions, may be modified to an almost endless extent, and yet the theory of operation remain the same.

We are also aware that jets of oil have been used for lubricating and washing the rifling-cutters both on horizontal and vertical machines; but in no instance has the rifling-rod entered a chamber sufficiently small to produce a strong longitudinal current in addition to the radial ones produced by the jets, nor has any attempt been made to produce a strong

current of oil over the cutters at both ends of the barrel for the purpose of cleaning away the chips. As the rifling-cut will be mainly made when pulling upon the rod, and not in the direction of thrust, the most efficient washing apparatus should be placed at the termination of the heaviest cut. It is possible one washing apparatus such as we have described, when placed at the point indicated, might be found sufficient. Hence we wish it clearly understood that we do not limit our invention to the specific devices described in elucidating its theory; but

What we do claim as new, and desire to secure by Letters Patent, is—

1. Arranging the movements of a machine for rifling gun-barrels in such a manner that they shall take in a series or order, the starting of each one of the series being dependent upon the final movement of the previous one of the series, substantially as and for the purpose specified.

2. Stopping the motion of the rifling-rod at one end of its stroke, and causing the other movements to take place, as described, while the rifling-rod is at rest.

3. Arranging the driving-power of the rifling-rod in such a manner that it shall be able to perform the work required, but will disconnect itself and stop under a strain too great for the rod to bear with safety.

4. The use of a washing box or boxes, substantially as described, and for the purpose specified.

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