No. 646,595.

Patented Apr. 3, 1900.

F. W. BROOKS.

ORDNANCE.

(Application filed Apr. 17, 1899.)

(No Model.)

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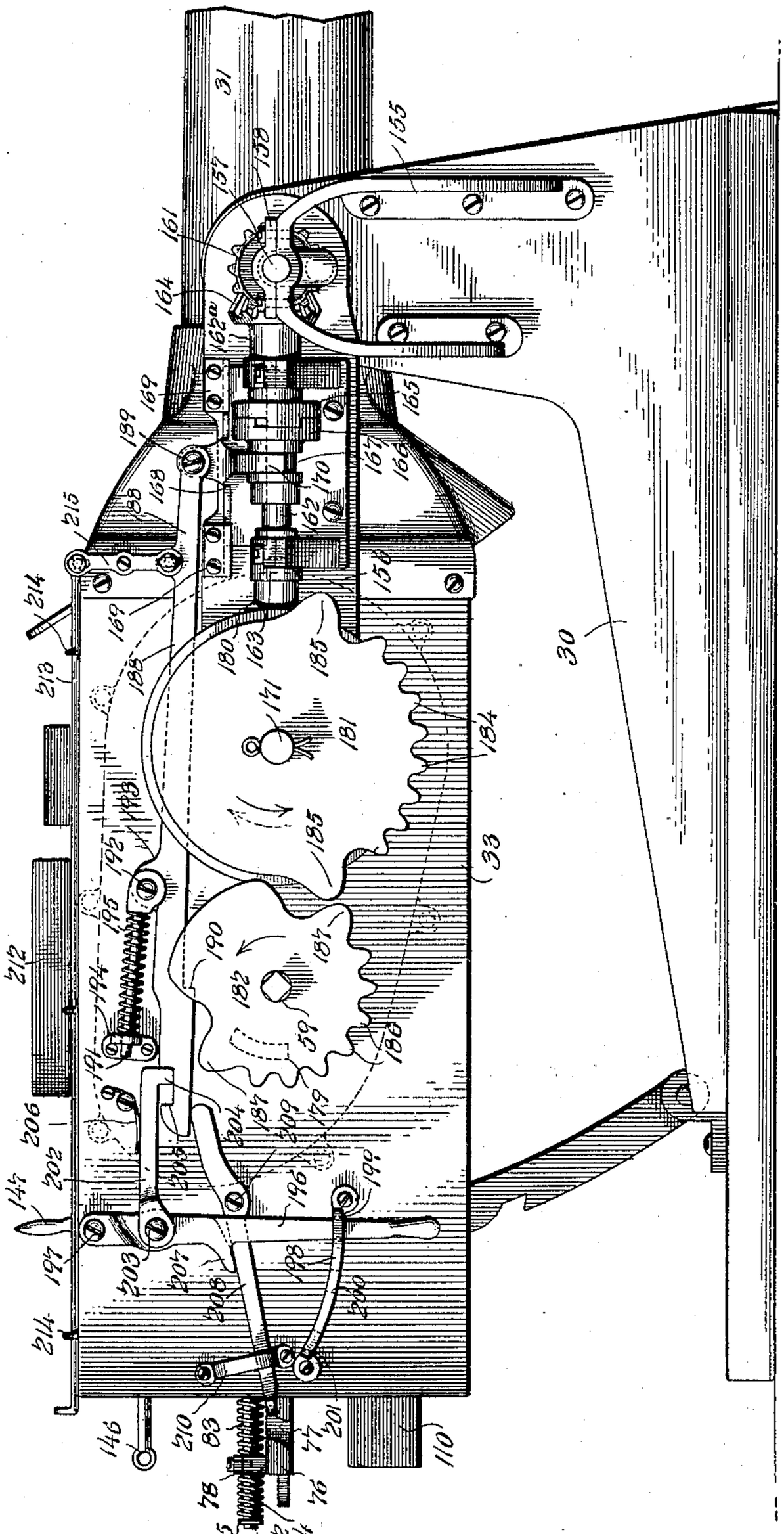

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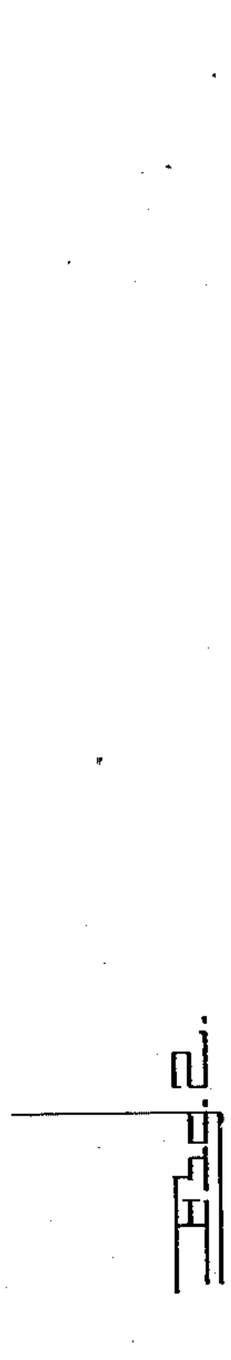

FIG. 2.

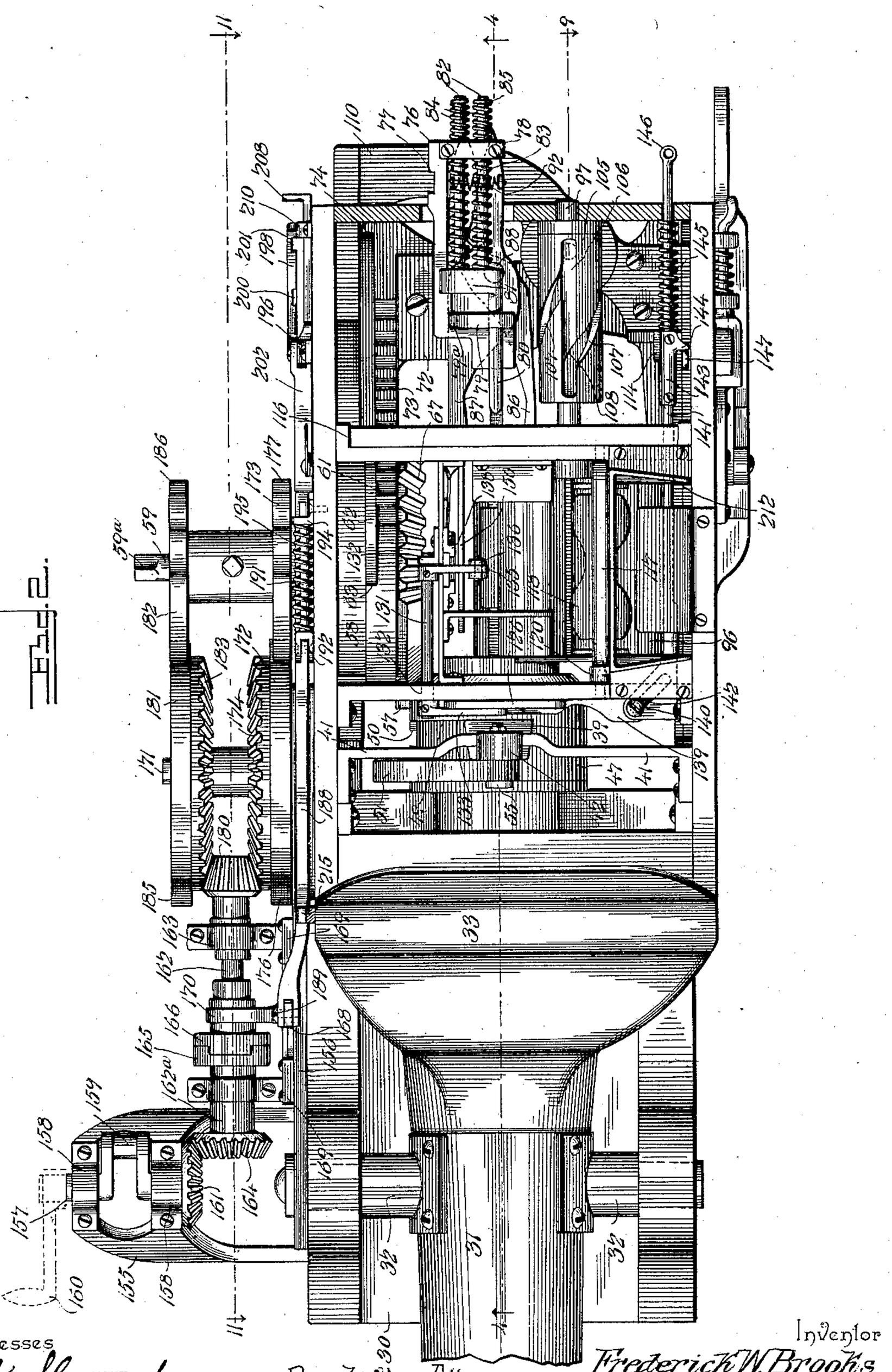

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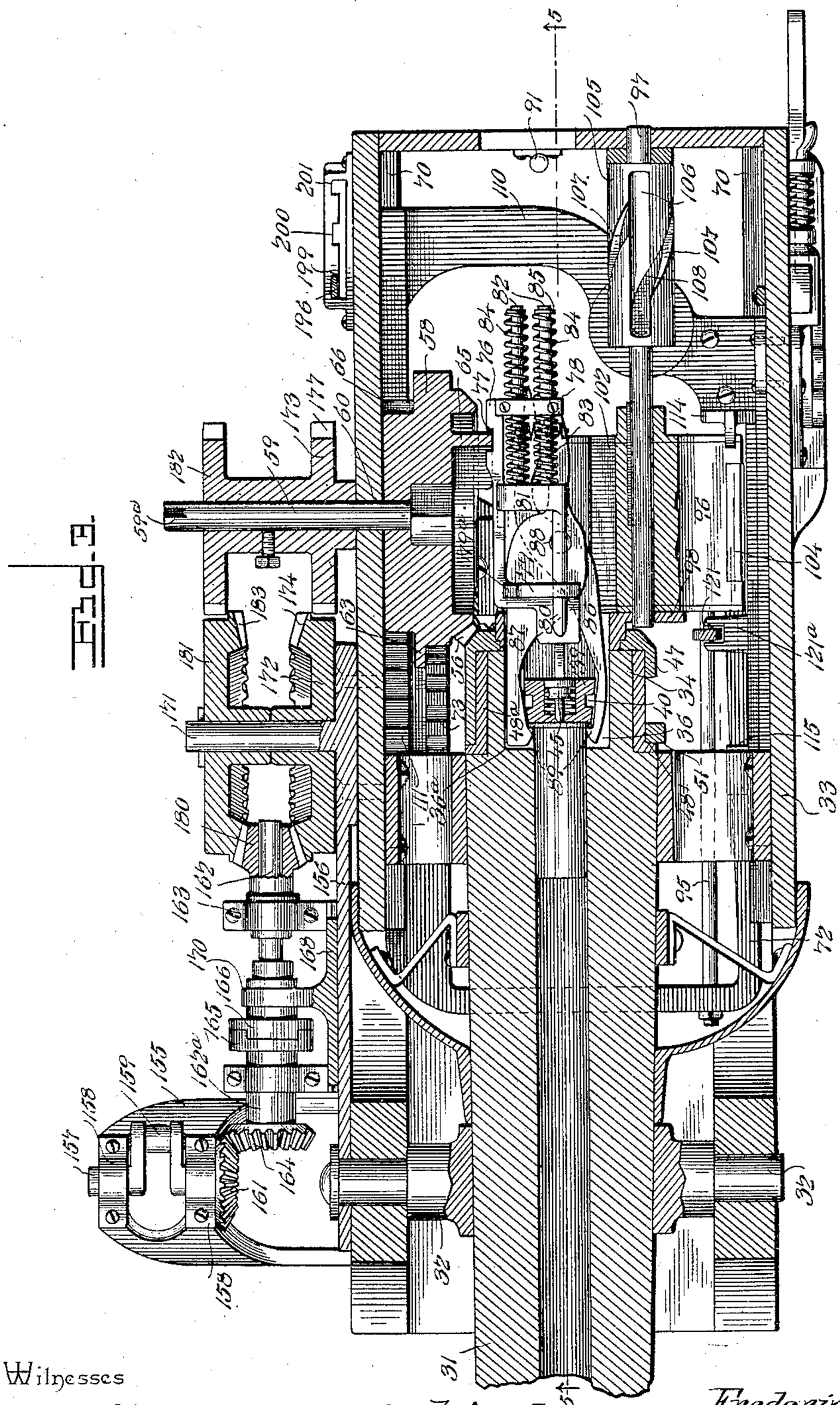
Fig. 5.



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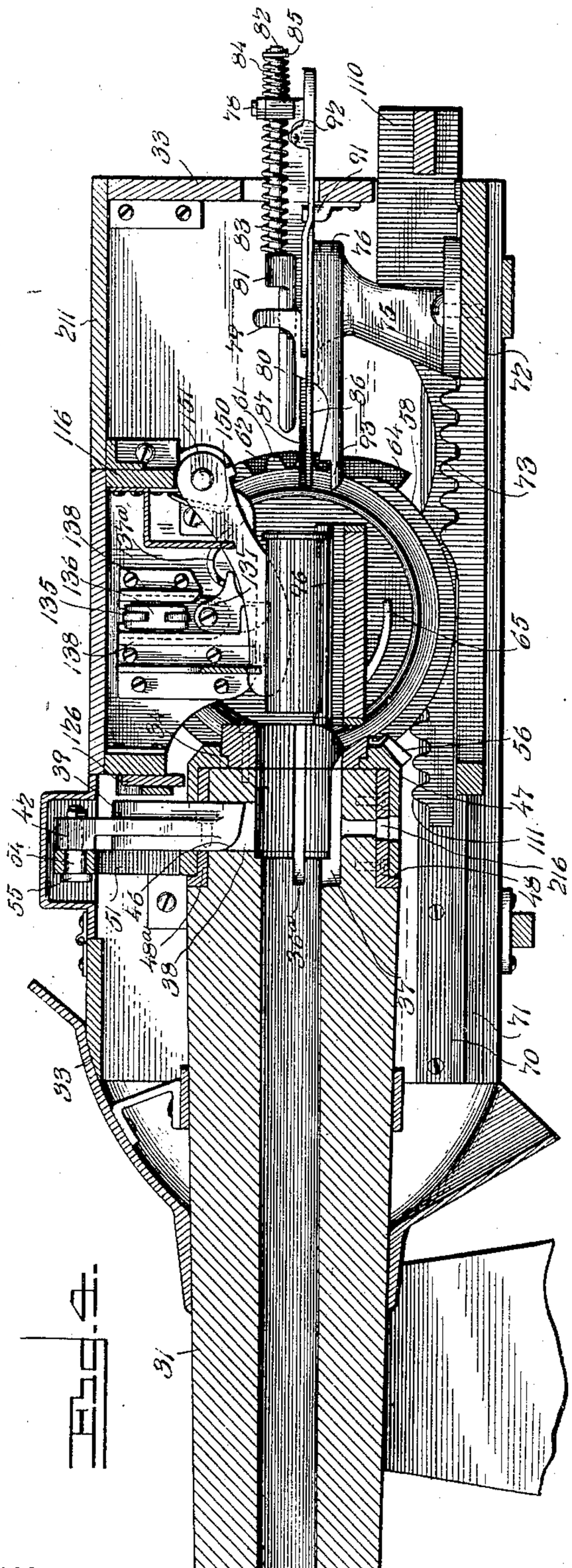

Fig. 4.

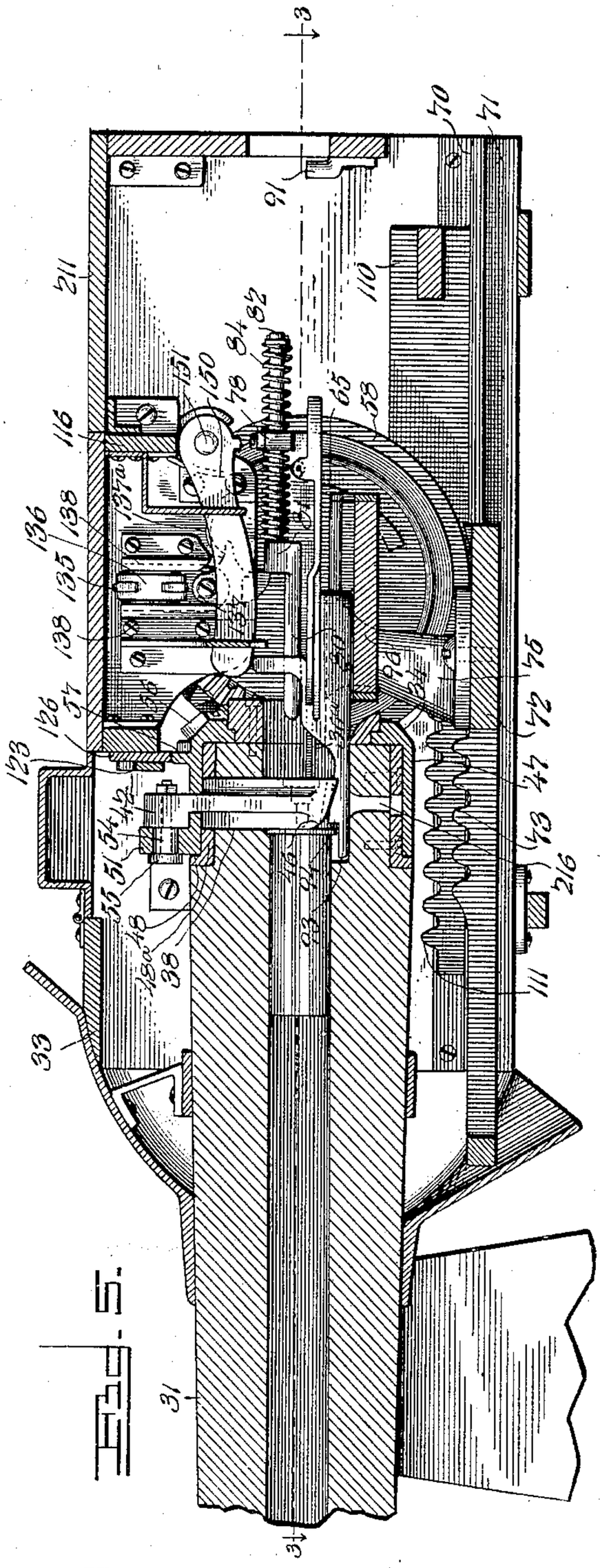

Fig. 5.

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Fig. 6.

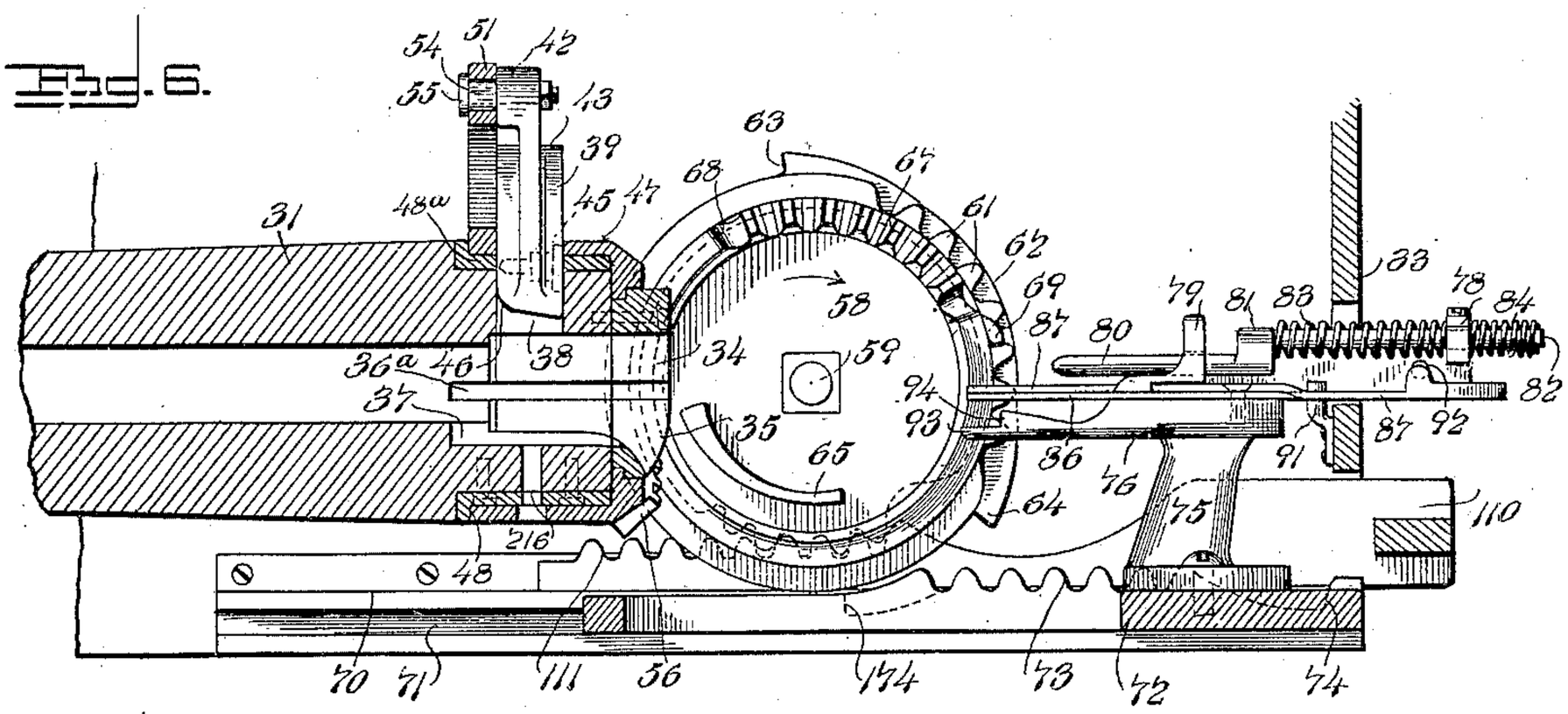

Fig. 7.

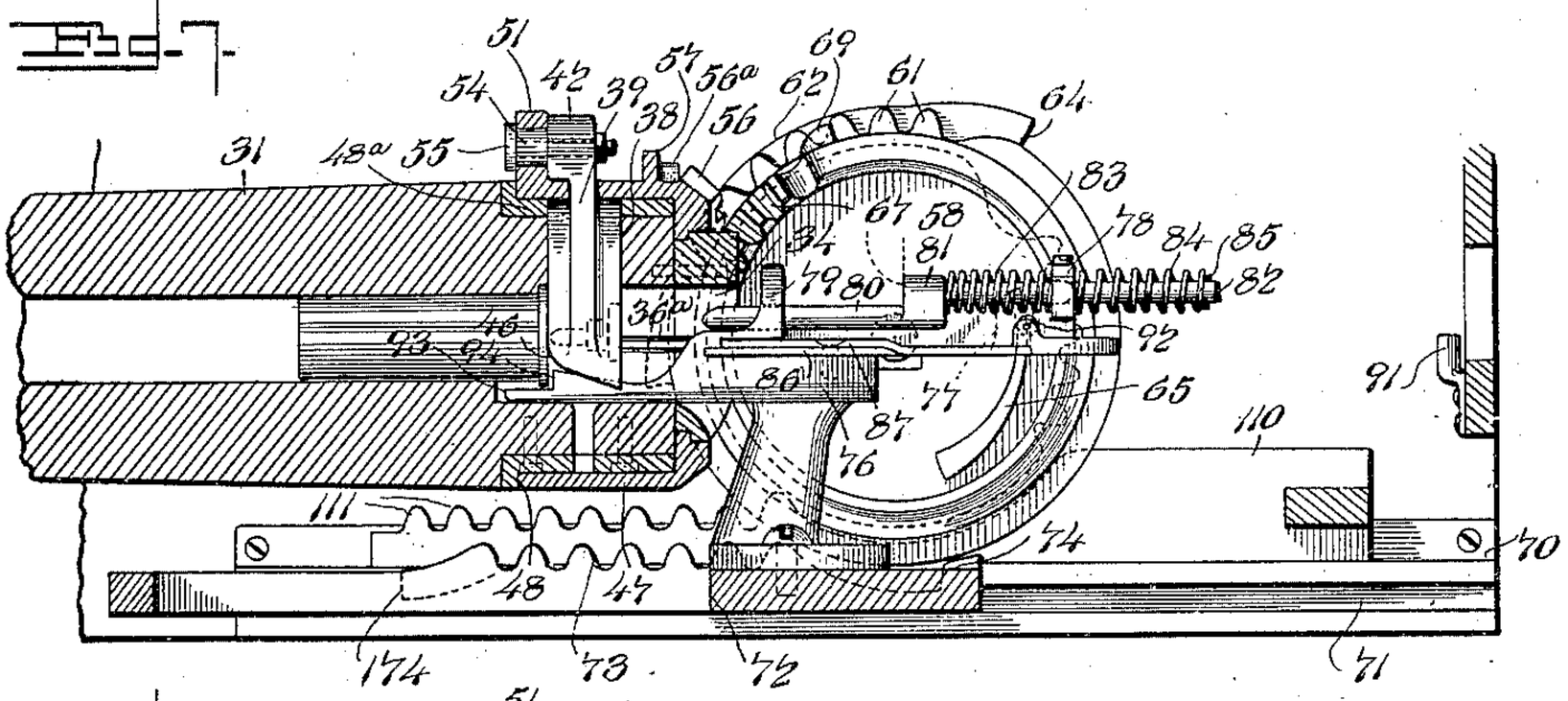

Fig. 8.

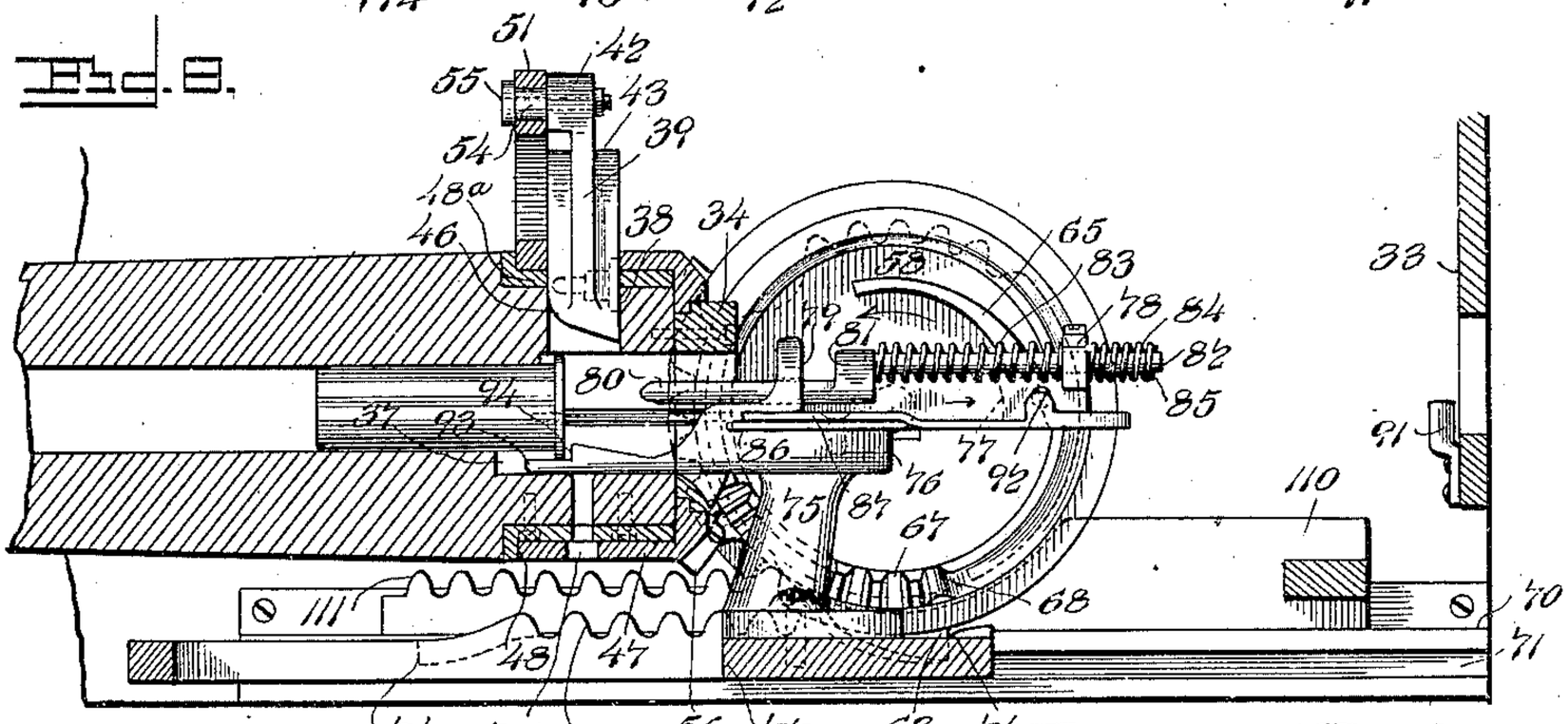

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Fig. 9.

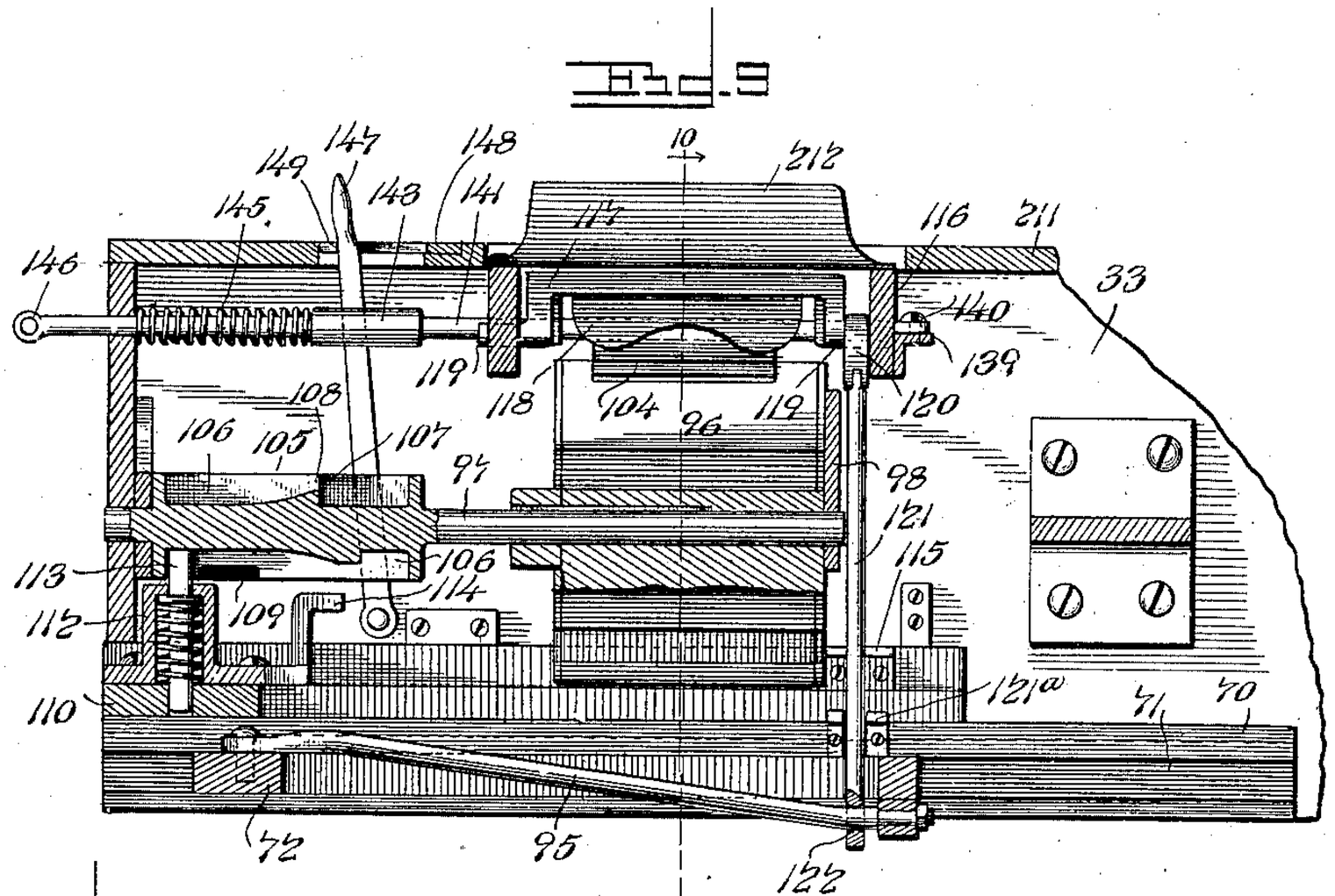


Fig. 29.

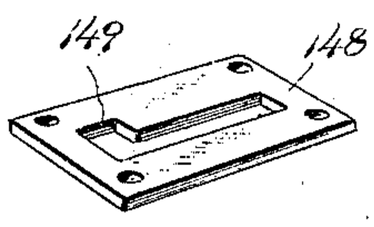
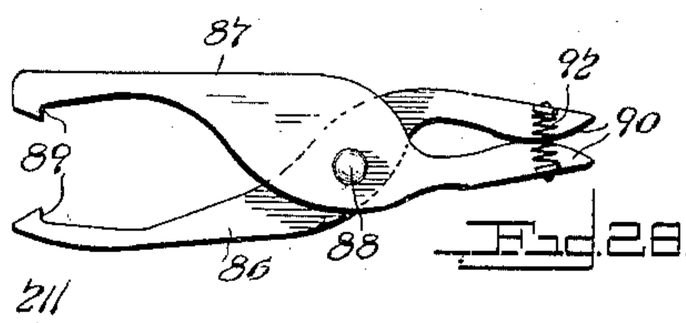


Fig. 10.

Fig. 28.



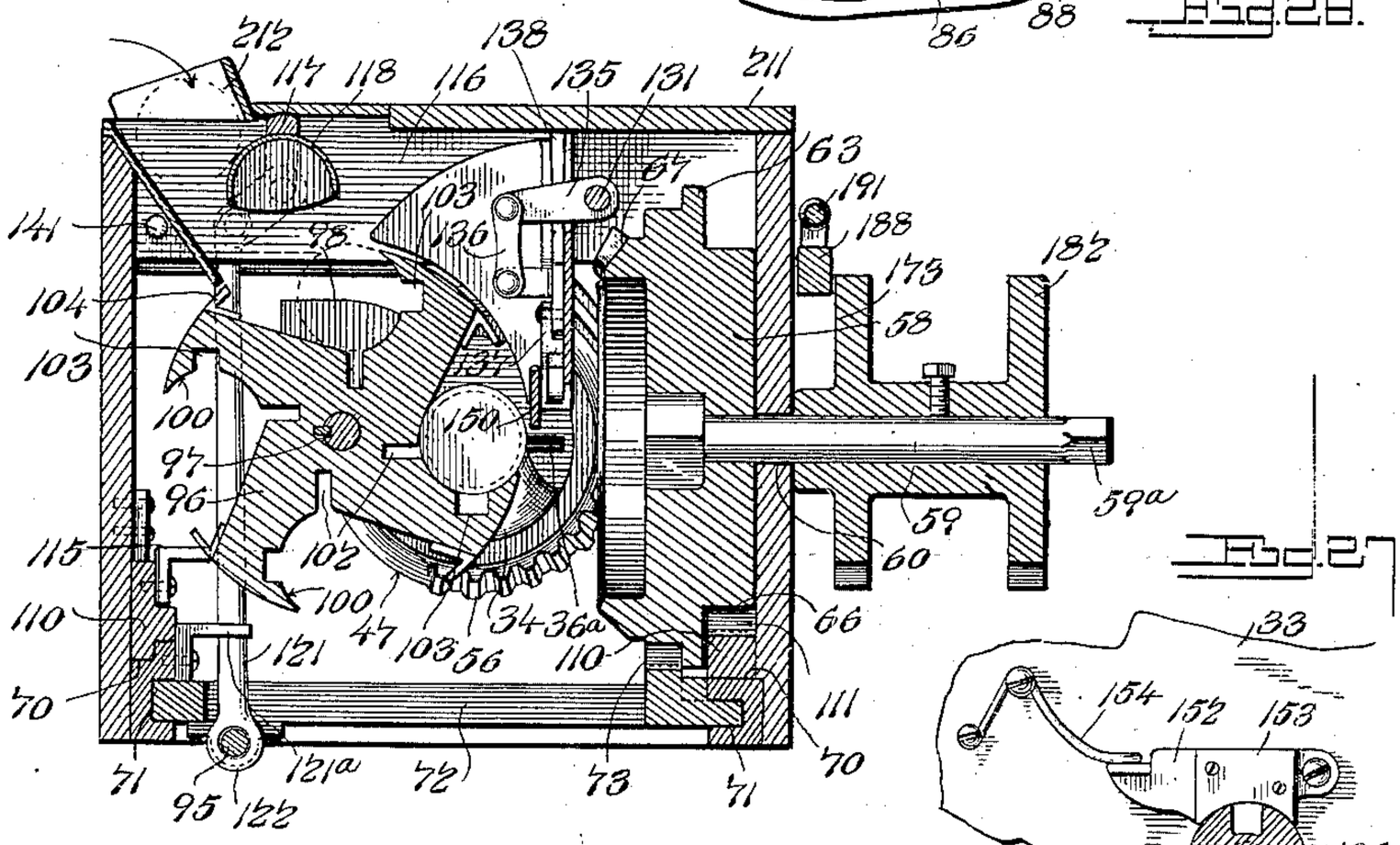


Fig. 27.

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FIG. 11.

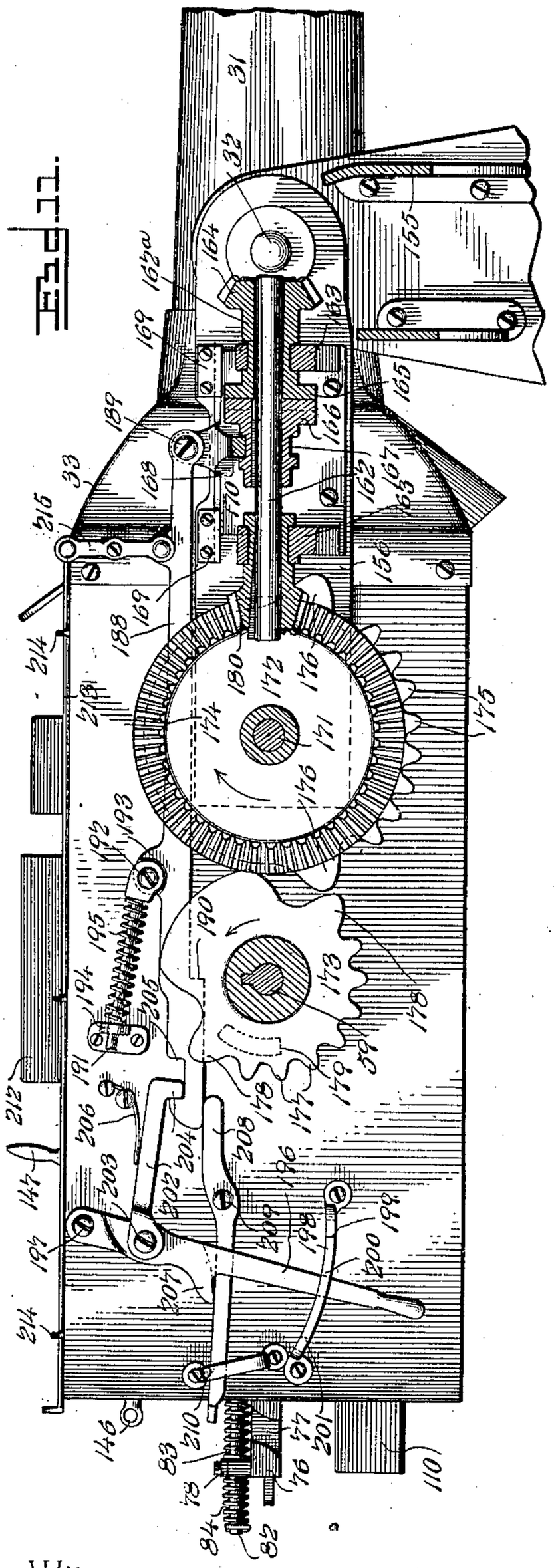

FIG. 12.

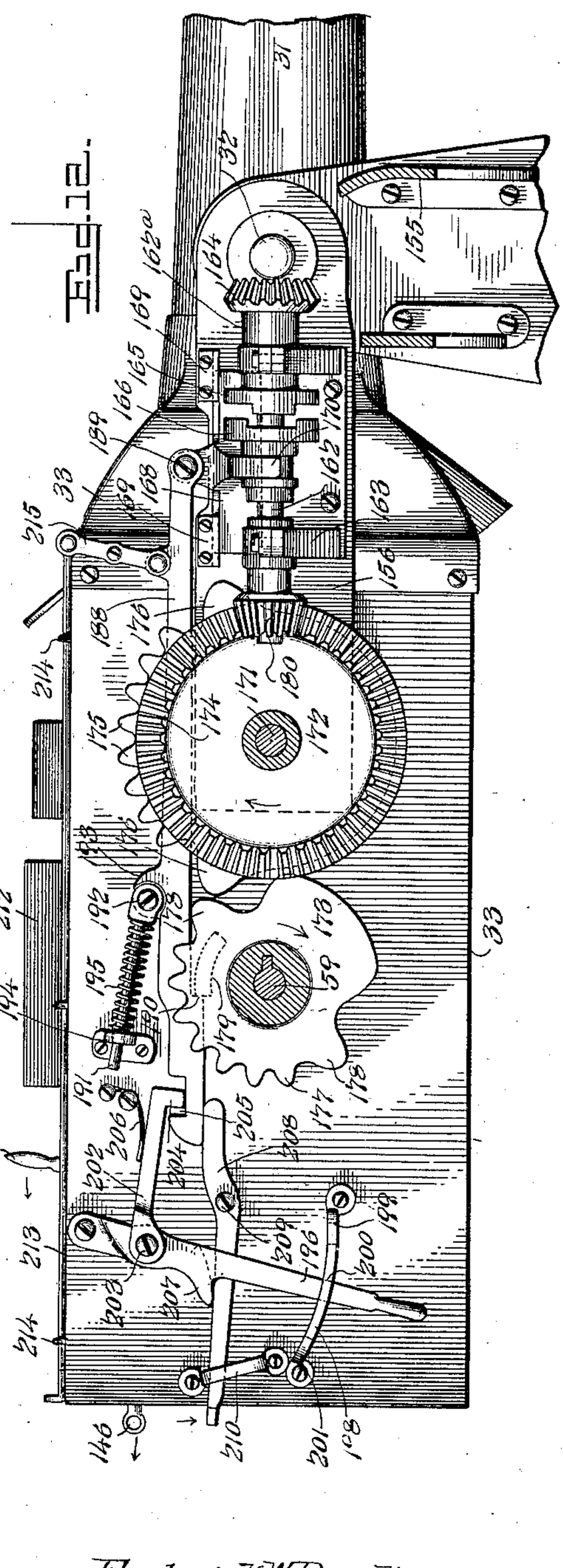

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Fig. 13.

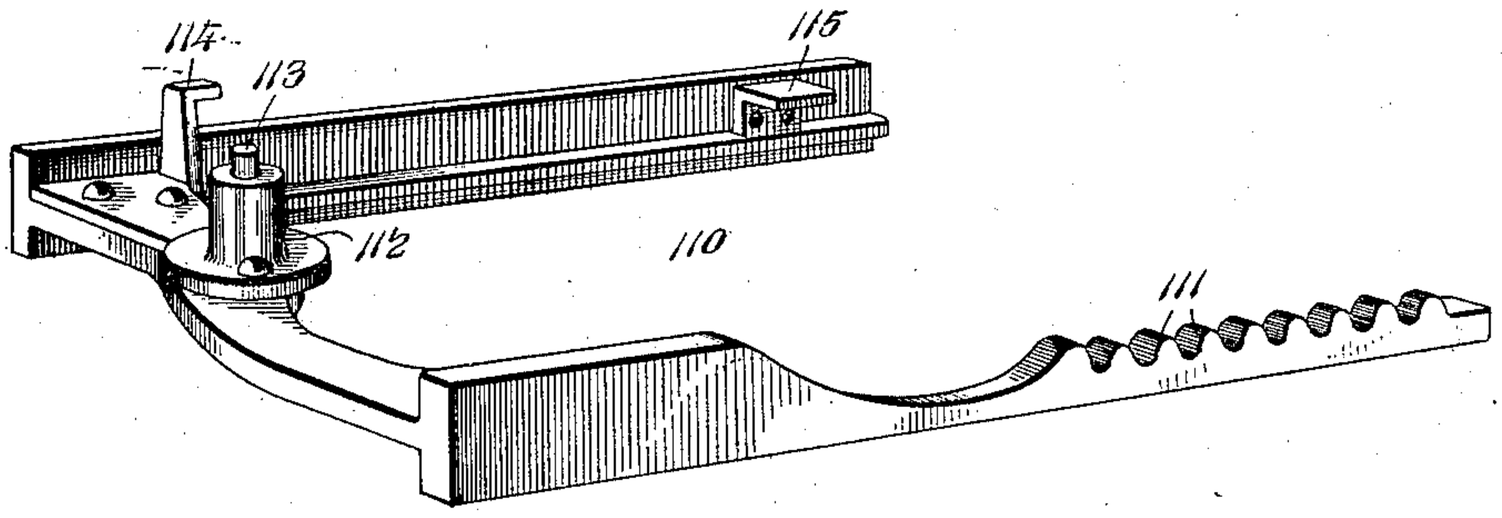

Fig. 14.

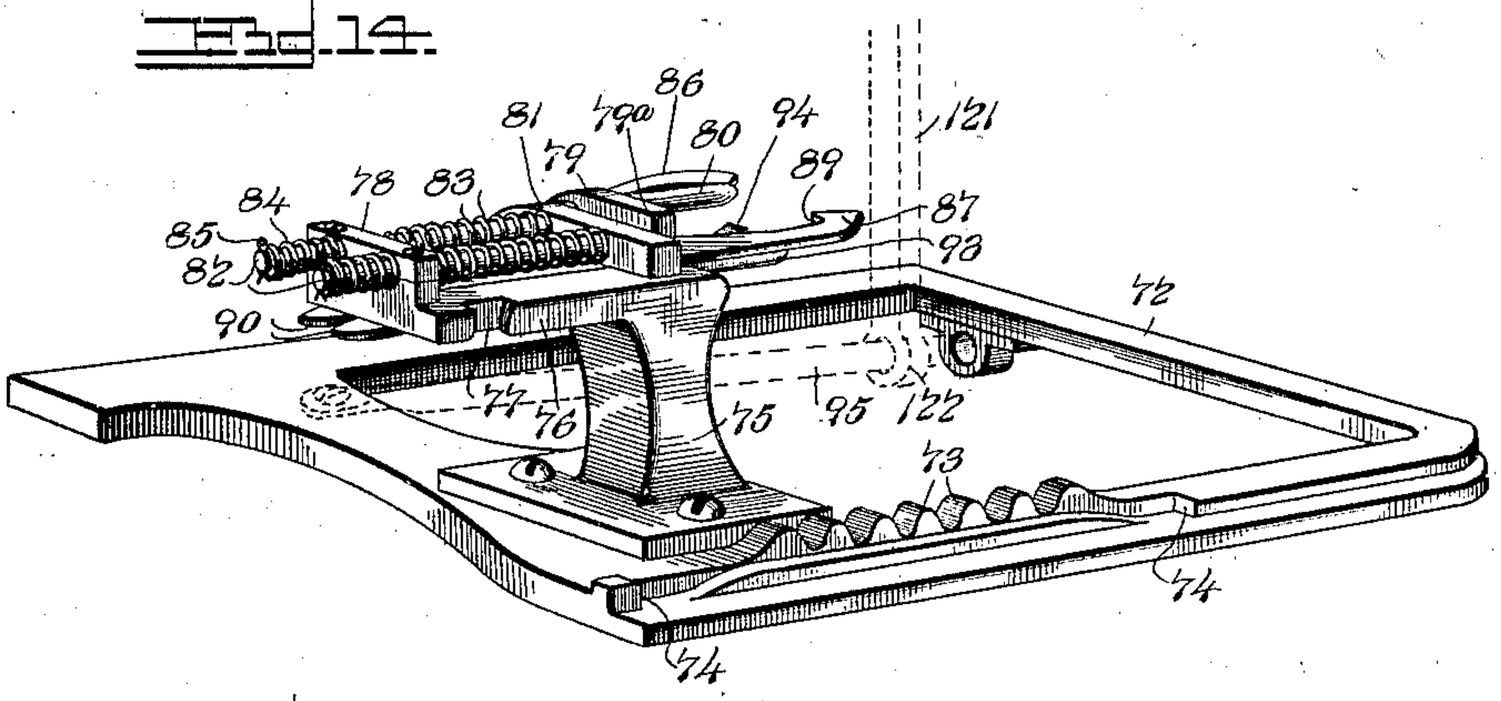

Fig. 15.

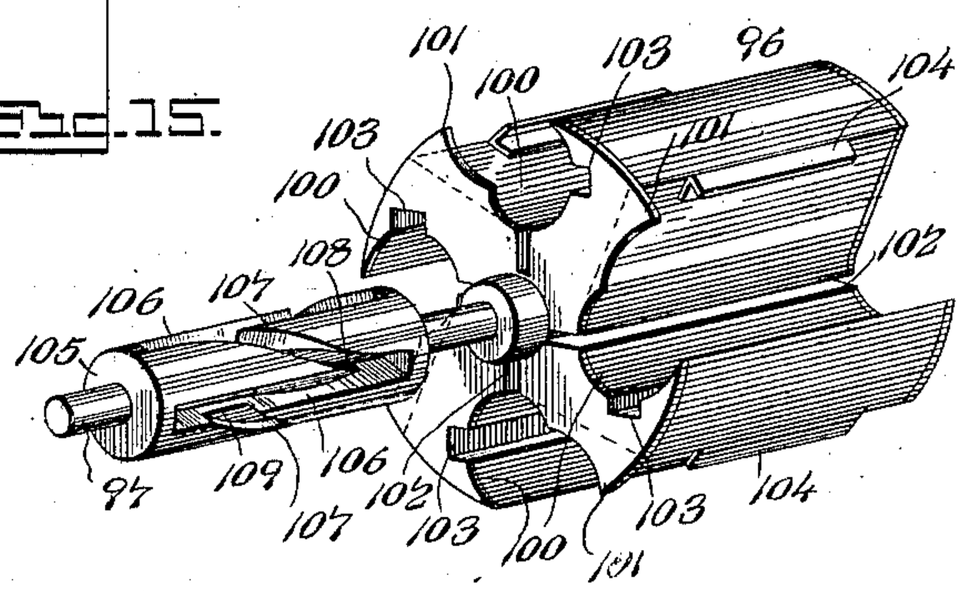

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Fig. 16.

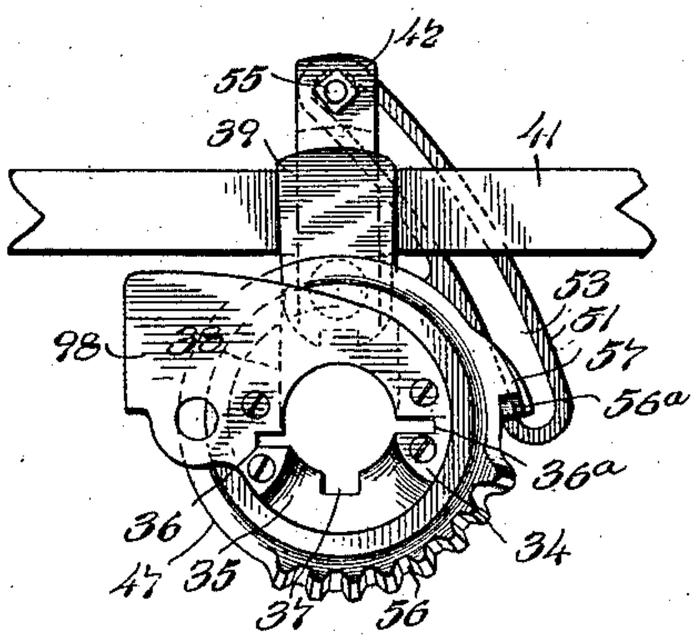


Fig. 17.

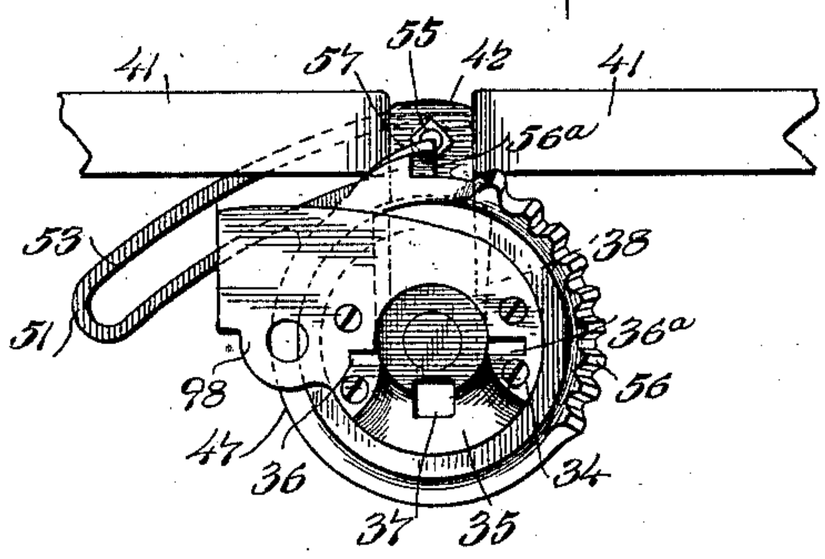
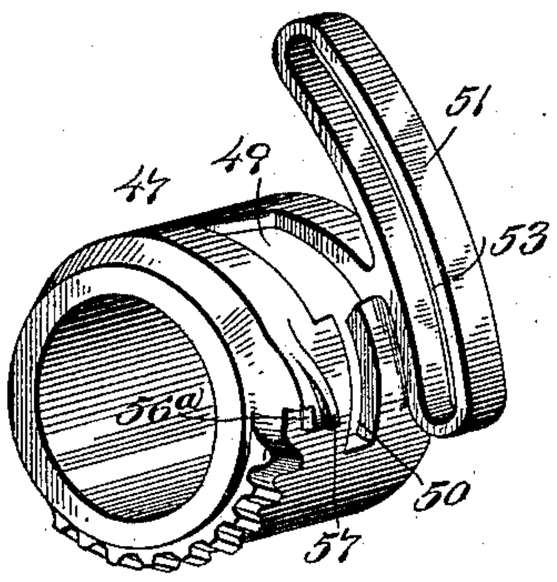


Fig. 18.



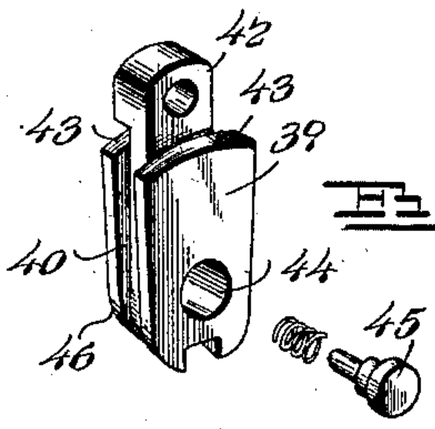


Fig. 19.

Fig. 20.

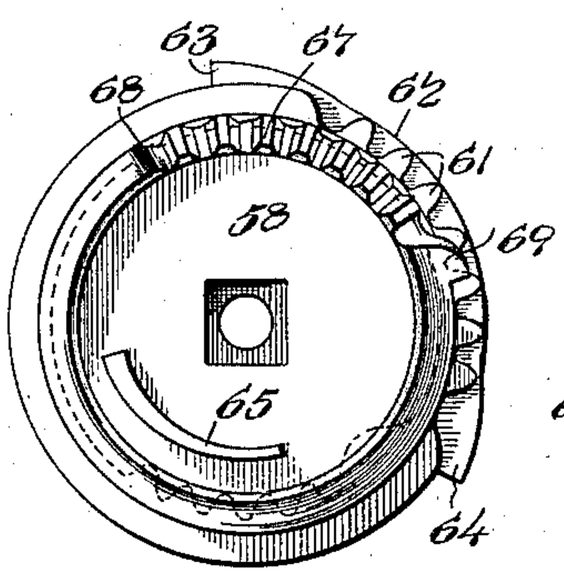
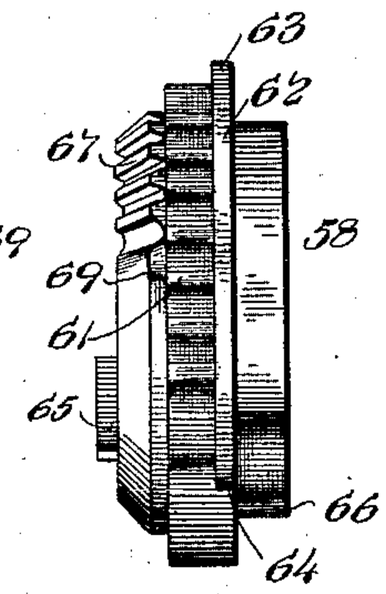


Fig. 21.



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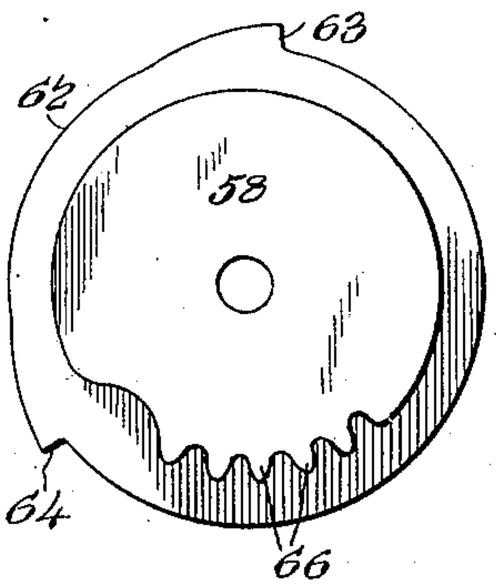

Witnesses
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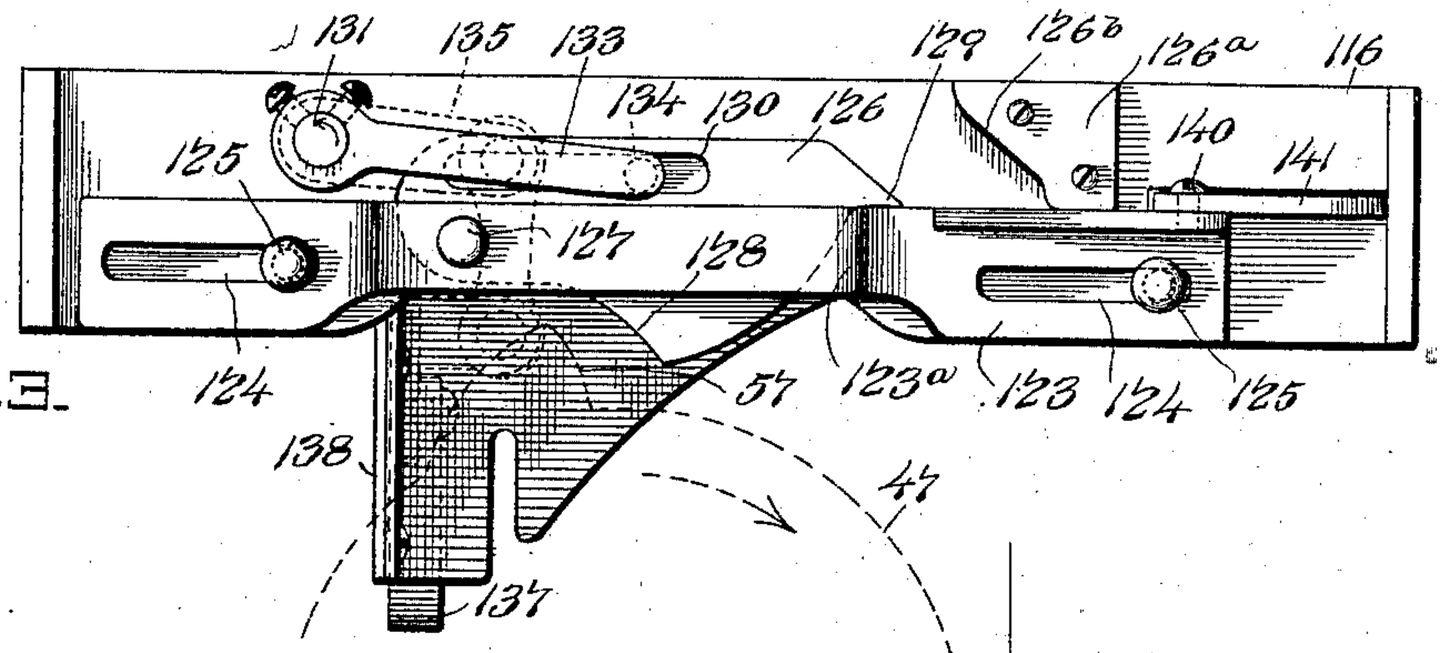

Fig. 23.

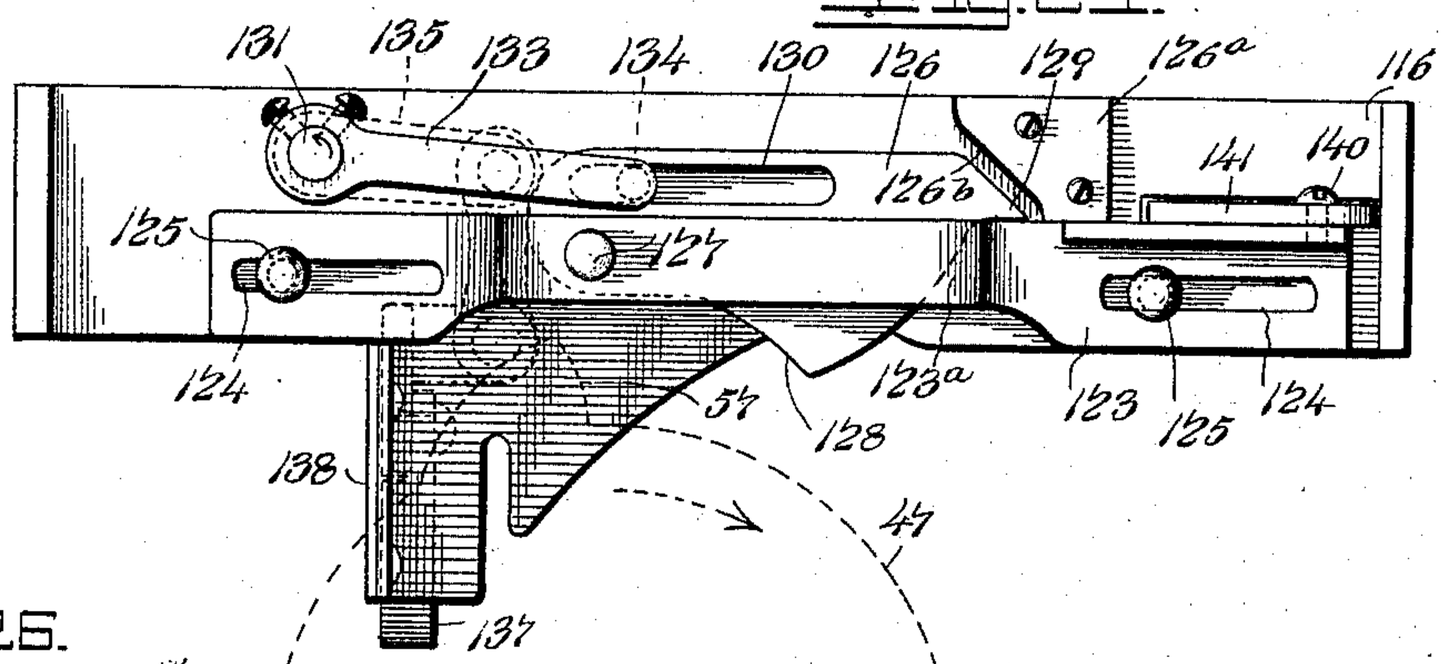

Fig. 24.

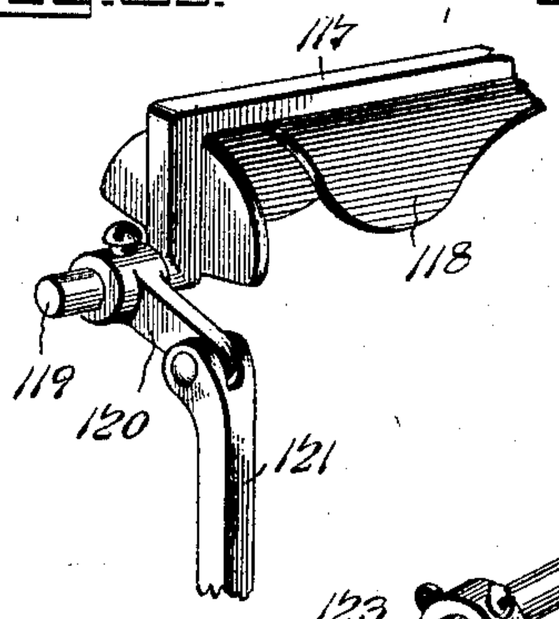

Fig. 26.

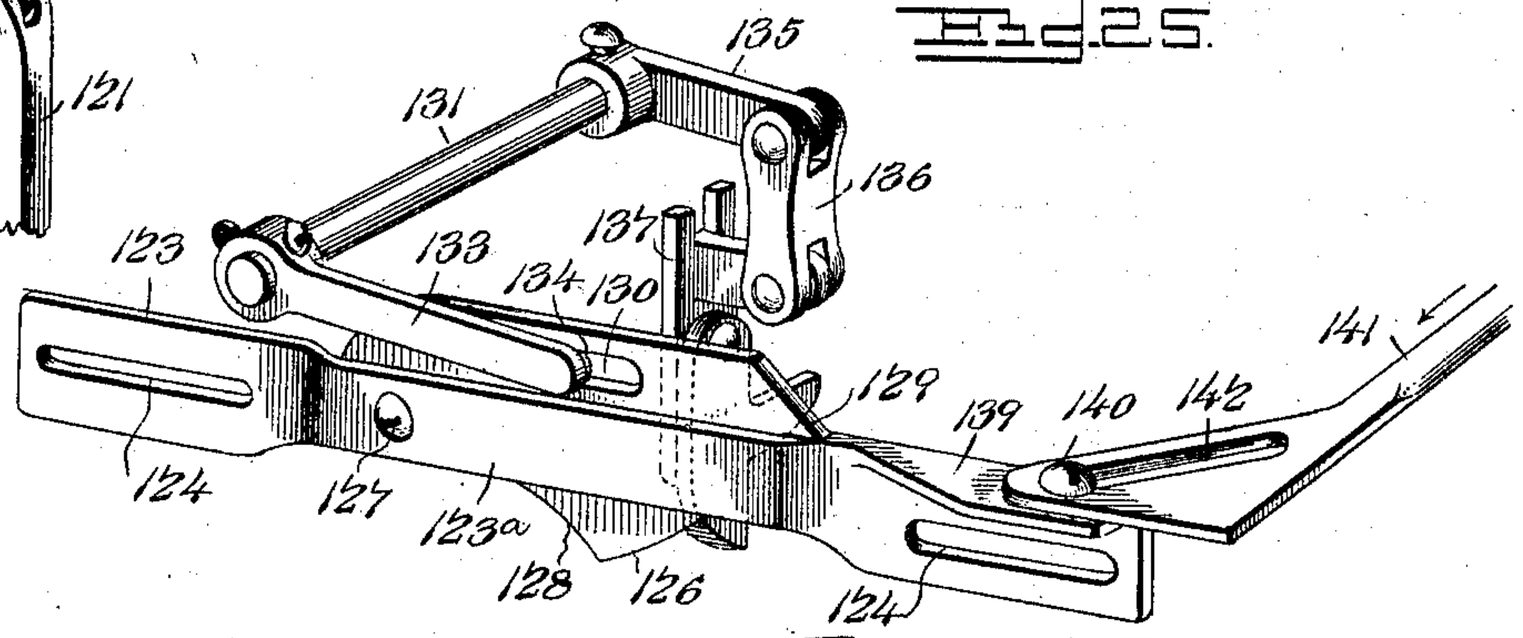

Fig. 25.

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UNITED STATES PATENT OFFICE.

FREDERICK W. BROOKS, OF WEST SUPERIOR, WISCONSIN.

ORDNANCE.

SPECIFICATION forming part of Letters Patent No. 646,595, dated April 3, 1900.

Application filed April 17, 1899. Serial No. 713,386. (No model.)

To all whom it may concern:

Be it known that I, FREDERICK W. BROOKS, a citizen of the United States, residing at West Superior, in the county of Douglas and State of Wisconsin, have invented new and useful Ordnance, of which the following is a specification.

My invention relates to improvements in cannon, which may be embodied in guns of small caliber especially designed for rapid firing of fixed ammunition or in ordnance of relatively-large caliber adapted to the use of fixed ammunition or separate charges of the explosive and projectile.

The primary object of the present invention is to produce ordnance which may be loaded and discharged manually or which may be loaded by power and fired manually to adapt the gun for aimed shots, or which may be loaded and fired automatically by power, and thus only require the gun to be sighted by the attendant.

According to my invention the charge, usually of fixed ammunition, is fed automatically to a reciprocating loading-carriage having the firing-bolt. Said loading-carriage is advanced to introduce the charge into the gun-breech and simultaneously set the firing-bolt for action, and then the breech-block is moved to close the gun-breech and bring the firing-pin which is carried by the breech-block into alinement with the set firing-bolt. This bolt may be released either manually or automatically to impel the firing-bolt against the firing-pin, and thereby act on the primer to explode the charge. The breech-block is now reversed and opened, the extractor on the loading-carriage grips the shell of the exploded charge, said carriage is retracted to move the shell out of the breech, and finally the shell is discharged previous to loading the carriage with another ammunition charge. The advancement and retraction of the loading-carriage with the firing-bolt and extractor is effected automatically by a master-gear adapted to be turned first in one direction and then in the opposite direction, and with said master-gear is associated a reversing clutch and driving mechanism adapted to be driven continuously in either direction by hand or by power for giving the necessary rotation to said master-gear. Said reversing clutch and driving mechanism may be said, briefly, to embody a power-shaft, a countershaft carrying clutch devices, two sets of mutilated gears adapted to be driven continuously in opposite directions by said countershaft, a shipping-rod connected with the clutch devices and controlled under certain conditions by a cam on one of said gears, means for manually adjusting the shipping-rod, and setting devices which are associated with the shipping-rod, and the adjusting means which controls the clutch mechanism.

With the loading-carriage is combined a revoluble feed-cylinder adapted to supply the ammunition charge to said carriage and the breech, said feed-cylinder being rotated with a step-by-step feed to present the ammunition charges successively in alinement with said breech. Said feed-cylinder is actuated at proper intervals by a secondary carriage, which will hereinafter be termed a "feed-cylinder-operating carriage," that is adapted to be actuated from the master-gear alternately with the loading-carriage, and said feed-cylinder-operating carriage is equipped with devices that operate to lock the feed-cylinder against rotation on its axis during the periods of loading and extracting the charge.

The charges of fixed ammunition in quick-firing and machine guns are supplied one at a time to the feed-cylinder by an oscillating feeder which is rocked in the intervals between the rotation of said feed-cylinder, and said feeder serves to properly introduce the ammunition charge into the feed-cylinder when the gun is working at high speed.

My invention also contemplates the employment of a vertically-movable breech-block and means for automatically adjusting the same during the periods of loading and extracting the ammunition charges. Said breech-block is constructed to force the ammunition charge tightly to its place in the breech, and it carries the firing-pin, which is arranged to be alined with the firing-bolt on the loading-carriage. With the breech-block is combined an adjusting and locking ring or sleeve that is driven from the master-gear to raise the breech-block after the shell of the ammunition charge shall have been exploded, said ring or sleeve serving also to lower the

breech-block on the insertion of the charge. This ring or sleeve has positive cam connections with the breech-block and is arranged to have interlocking engagement with the breech-block in order to lock said block firmly to its seated position in the breech, and said ring is furthermore provided with a cam-lug that is adapted to work in connection with the firing mechanism. This firing mechanism is arranged for operation automatically or by hand under different conditions in the service of the gun. Said firing mechanism includes a sear guided for reciprocating movement into and out of the path of the firing-bolt, and linked to this sear is a rock-shaft having connection with a cam-plate which is capable of both reciprocating and pivotal play, said cam-plate being adapted for engagement with the cam-lug on the sleeve or ring which controls the breech-block. The cam-plate of the firing mechanism is pivoted to and carried by a reciprocating carrier-plate that is disposed over a ring or sleeve, and an operating-rod has cam-slotted connection with said reciprocating carrier-plate. This operating-rod is controlled by a spring and is adapted to be locked in a retracted position by a lever when the firing mechanism is actuated automatically.

The invention further consists in the novel combination of instrumentalities and in the construction, arrangement, and adaptation of the various parts for service, as will be hereinafter more fully described and claimed.

To enable others to understand the invention, I have illustrated the preferred embodiment thereof in the accompanying drawings, forming a part of this specification, and in which—

Figure 1 is a side elevation of my improved ordnance with the muzzle broken away and illustrating the reversing clutch-driving mechanism adjusted to automatically load, fire, and extract the ammunition charge. Fig. 2 is a plan view of the ordnance represented by Fig. 1, showing the top of the casing removed and the gun partly broken away, the loading-carriage which supports the firing-bolt and extractor being shown in the retracted positions ready to engage with the ammunition charge in the feed-cylinder previous to forcing said charge into the gun-breech. Fig. 3 is a horizontal sectional plan view on the plane indicated by the dotted line 3 3 of Fig. 5, the loading-carriage being shown in its advanced position and the firing-bolt retracted and set in a position to be released for actuation against the firing-pin of the breech-block. Fig. 4 is a vertical sectional elevation taken longitudinally through the ordnance on the plane indicated by the dotted line 4 4 of Fig. 2. Fig. 5 is a vertical longitudinal section on the plane indicated by the dotted line 5 5 of Fig. 3, the several working elements of the ordnance being represented in corresponding positions in both Figs. 3 and 5. Figs. 6, 7, and 8 are vertical detail longitudinal sectional views illustrating the several positions of the loading and feed-cylinder-operating carriages in relation to the master-gear, Fig. 6 showing the positions of the firing-bolt and the breech-block with relation to the master-gear previous to introducing the ammunition-charge into the breech, Fig. 7 illustrating the breech-block in its lowered position subsequent to the introduction of the charge into the breech and with the firing-bolt retracted, so as to be under the influence of its impelling-springs, and Fig. 8 illustrating the breech-block in its raised position and with the extractor engaged with the shell of the exploded charge previous to retracting said shell from the breech and placing the shell in position within the chamber of the revoluble magazine. Fig. 9 is a vertical longitudinal section at one side of the axis of the gun and taken through the revoluble feed-cylinder and its oscillating feeder, also showing a part of the firing mechanism, the plane of section being indicated by the dotted line 9 9 on Fig. 2. Fig. 10 is a vertical transverse sectional elevation through the master-gear and the revoluble feed-cylinder with the parts associated therewith, the plane of section being indicated by the dotted line 10 10 on Fig. 9. Fig. 11 is a sectional side elevation of the reversing clutch-driving mechanism, showing the latter adjusted to load the gun by power, the plane of the section being indicated by the dotted line 11 11 on Fig. 2 looking in the direction indicated by the arrow. Fig. 12 is a sectional side elevation similar to Fig. 11, but showing the reversing clutch-driving mechanism acting on the clutch-shipping rod to automatically throw the gearing out of operative relation to the power-shaft, whereby the firing mechanism may be controlled by hand after the ammunition charge shall have been loaded into the breech and the firing-bolt set in its operative relation to the firing-pin. Fig. 13 is a detail perspective view of the slidable feed-cylinder-operating carriage removed from the housing or casing for the operating mechanism, said carriage being adapted for operation by the master-gear and equipped with a feed device that engages with the cam-slotted sleeve on the shaft of the revoluble magazine to rotate the latter with a step-by-step feed. Fig. 14 is a similar detail perspective view of the lower loading-carriage, illustrating the firing-bolt and the shell-extractor. Fig. 15 is a detail perspective view of the revoluble feed-cylinder, its shaft, and the cam-slotted feed-cylinder removed from the housing or casing of the gun. Fig. 16 is a detail rear elevation of the gun-breech, showing the relation of the breech-block and the ring or sleeve which controls said breech-block, the block being represented in its raised position. Fig. 17 is a view similar to Fig. 16, but showing the parts in their reversed positions to firmly force the breech-block to its seat in the gun-breech after the ammunition

charge shall have been placed therein. Fig. 18 is a detail perspective view of the adjusting and locking ring or sleeve that is driven from the master-gear and is adapted to control the breech-block and to work in connection with the cam-plate of the firing mechanism. Fig. 19 is a detail perspective view of the breech-block removed from the gun-breech and the ring or sleeve. Figs. 20, 21, and 22 are detail views of the master-gear that is adapted to operate the loading-carriage, the feed-cylinder-operating carriage, and the breech-block, Fig. 20 being a face view from one side of the gear, Fig. 21 being an edge view, and Fig. 22 a face view, showing the reverse side of the gear. Fig. 23 is an enlarged detail view in elevation of a part of the supplementary frame within the housing or casing for the operative parts of the gun, said figure representing a part of the firing mechanism adapted to be operated automatically by the cam-lug on the ring or sleeve of the gun-breech, whereby the firing-bolt may be released automatically to explode the ammunition charge. Fig. 24 is a view similar to Fig. 23, representing the firing mechanism adapted for operation by hand, the cam-slotted plate of said firing mechanism being movable with the reciprocating carrier-plate that is adjusted endwise by the firing rod or lanyard to bring the cam-plate into contact with the cam-lug on the ring or sleeve. Fig. 25 is a detail perspective view of part of the firing mechanism, to more clearly show the construction and relation of the several parts thereof. Fig. 26 is a fragmentary detail perspective view of a part of the oscillating feeder which is used in connection with the revoluble feed-cylinder when the ordnance is adapted to quick-firing guns. Fig. 27 is a detail sectional view of the spring-controlled brake, which assists in restraining the feed-cylinder from rotation during the period of loading and extracting the ammunition charge. Fig. 28 is a detail view of the extractor device detached from the loading-carriage. Fig. 29 is a detail view of the slotted detent-plate by which the locking-lever of the firing mechanism may be held in the retracted position.

The same numerals of reference are used to indicate like and corresponding parts in each of the several figures of the drawings.

The bed 30, which carries the gun 31, may be of any usual or preferred construction, and the gun itself may be of the single-piece construction or of the "built-up" variety. As is usual in the art, the gun 31 is provided near its breech with the trunnions 32, that are mounted in proper bearings on the bed 30 for the elevation and depression of the gun.

Secured firmly to the gun 31, between its breech and the trunnions, is a main frame or housing 33, which is movable with the gun and is adapted to sustain the operating mechanism by which the charges are introduced into the gun, fired, and extracted. This frame or housing 33 may be of the construction shown by Figs. 1 to 5, inclusive; but said housing may be varied in material respects within the province of a skilled constructor. The housing forms a chamber adapted to contain and conceal nearly all of the working elements except the reversing clutch-driving mechanism that is disposed on the outside of the housing and the gun, as clearly shown by Figs. 1, 2, 3, 10, and 11. The breech 34 of the gun is provided on its lower side with the rounded or beveled surface 35, adapted to guide or direct the ammunition charge into the bore, and in the bore at the end of the breech are provided the longitudinal grooves 36 36^a, which are disposed parallel to the axis of the gun and on diametrically-opposite sides of the bore thereof. (See Figs. 16 and 17.) These radial grooves 36 36^a extend a suitable distance into the breech 34 to accommodate the members of the shell-extractor. The breech is furthermore provided in its lower side with a parallel groove 37, the length of which is equal to that of the extractor-grooves previously described, and this lower groove 37 receives the pusher-arm on the loading-carriage, by which the ammunition charge is introduced into the breech. The gun-breech 34 is furthermore provided with a vertical guideway 38, (indicated by dotted lines in Figs. 16 and 17,) and this vertical guideway is in a plane between the diametrically-opposite extractor-grooves 36 36^a.

The breech-block 39 is fitted snugly in the vertical guideway 38 of the breech, and said block is adapted to reciprocate in a vertical direction and across the bore of the gun-breech. Said breech-block is provided in its opposite vertical edges with longitudinal grooves 40, (see Fig. 19,) and with the grooved faces of said breech-block engages the fixed guides 41, which span the space between sides of the frame or housing 33 and serve to direct the breech-block in its vertical play with relation to the gun-bore. As shown by Fig. 19, the upper end of the breech-block is reduced in thickness to form the connecting-finger 42, and on opposite sides of this connecting-finger the breech-block 39 is provided with curved edges 43, upon which is adapted to ride the adjusting and locking ring when the breech-block is lowered to position across the bore, as will hereinafter appear. The breech-block is furthermore provided at a point intermediate its length with a transverse socket or opening 44, in which is contained the spring-pressed firing-pin 45. This firing-pin is mounted in the breech-block to travel therewith; but the pin is capable of a limited endwise movement in the breech-block transversely to the path of vertical movement thereof, whereby the firing-pin is adjusted on the lowering of the breech-block into alinement with the firing-bolt and with the primer of the ammunition charge, which is placed in the gun-breech previous to lowering the breech-block. The inner face of the breech-block, which lies next to the ammunition

charge, is formed with a beveled or curved portion 46, (see Figs. 4 to 8, inclusive,) and after the ammunition charge shall have been introduced into the breech the block 39 is lowered for its beveled face 46 to impinge against the butt-end of the charge, whereby the lowering of the breech-block forces the charge with a wedging action firmly into the breech 34, as graphically represented by Figs. 5 and 7.

One of the important elements of my improved gun is the revoluble breech-block-adjuster ring or sleeve 47, which is fitted to the breech 34 and is connected operatively with the master-gear to be moved or turned positively thereby, and this ring or sleeve serves the important purpose of adjusting the breech-block in a vertical direction across the bore of the gun, of locking the breech-block firmly in its lowered position subsequently to the introduction of the ammunition, and of operating in connection with the cam-plate of the firing mechanism that sets and releases the firing-bolt. This ring or sleeve 47 is shown more clearly by the detail view Fig. 18 of the drawings. Said sleeve or ring is fitted loosely on a flanged or recessed seat 48 of the gun-breech, as shown by Figs. 3 to 8, inclusive, and this seat permits the ring or sleeve to turn freely in either direction on the axis of the gun-breech, but restrains the sleeve from endwise movement in either direction. The ring or sleeve is provided with a wide radial slot 49 and with a narrow slot 50, the two slots being contiguous and in communication, as shown by Fig. 18. The width of the slot 49 is sufficient for the breech-block 39 to pass freely through the ring when the latter is in one position; but on the lowering of the block and partial rotation of the ring or sleeve the finger 42 of the block enters the narrow radial slot 50, whereby the ring is adapted to impinge against the curved edges 43 at the upper end of the breech-block and confine said breech-block firmly to its seat when lowered across the bore of the gun-breech 34. The ring or sleeve is furthermore provided with a curved arm 51, which is fast with the sleeve to rock or turn therewith, and this arm is eccentric to the axis of the ring or sleeve and is disposed contiguous to the connecting-finger 42 of the breech-block. Said curved eccentric arm 51 is formed with a longitudinal arc-shaped slot 53, that is arranged to receive the friction-roller 54, which is mounted loosely on a pin 55, secured firmly to the outer end of the connecting-finger 42 on the breech-block. The friction-roller 54 is adapted to ride or travel freely within the slot of the eccentric arm when the latter is turned with the sleeve or ring, and the rocking or oscillating movement of this arm 51 with the ring or sleeve operates to raise or lower the breech-block, because the arm 51 is eccentric to the axis of the gun-bore. The eccentric arm affords a positive mechanical connection between the oscillating sleeve or ring and the reciprocating breech-block, and the latter is thus adapted to be raised and lowered positively. At the end of the gun near the open end of the breech the ring or sleeve is provided with a bevel gear-segment 56, the teeth of which are arranged to mesh with one series of teeth on the master-gear 58, and at the ends of this gear-segment the sleeve or ring is formed with a lug 56^a, arranged to coact with similar lugs on the master-gear, as will presently appear, in order to position the ring or sleeve for engagement of its gear-segment 56 with the master-gear in a manner to avoid stripping the teeth, particularly when the gun is working at high speed. Said ring or sleeve is furthermore provided on its cylindrical surface and contiguous to the bevel gear-segment with a cam-lug 57, which protrudes a sufficient distance beyond the surface of the sleeve and the segment for engagement with the cam-plate of the firing mechanism.

The master-gear 58 is secured fast to a horizontal shaft 59, which is journaled in a bearing 60 on one side of the frame or housing at a point intermediate the length thereof. This master-gear is disposed at one side of the axis of the gun, and it lies contiguous to the ring or sleeve 47 for engagement with the bevel gear-segment 56 thereof. The master-gear actuates the loading-carriage, the feed-cylinder-operating carriage, and the ring or sleeve for the breech-block at proper intervals, and to this end said master-gear is peculiarly fashioned or constructed with three several series of gear-segments, all as represented more clearly by Figs. 20 to 22, inclusive. The shaft 59, which carries the master-gear, is adapted to protrude beyond the housing or main frame 33 a sufficient distance for the reception of two mutilated gears forming parts of the train of oppositely-rotating gears by which the shaft 59 and the master-gear 58 may be driven in opposite directions, and one end of the shaft 59 is made square or polygonal, as at 59^a, (see Figs. 2 and 3,) for the purpose of receiving a crank by which the shaft 59 of the master-gear may be rotated directly in the event of injury to the reversing clutch-driving mechanism. For the operation of the loading-carriage the master-gear 58 is provided with a peripheral series of teeth 61, forming a segment which is adapted to mesh with a rack on said loading-carriage, and said gear 58 is furthermore provided with a segmental flange 62, forming the abrupt shoulders 63 64, which are disposed at opposite ends of the segment 61 and serve to engage with lugs on the loading-carriage in order to position said carriage for the engagement of the segment 61 with the carriage-rack and to avoid stripping the gear-teeth. The master-gear is furthermore provided on its face which lies contiguous to the loading-carriage with an eccentric or cam rib 65, (see Fig. 20,) which is arranged to engage with a part of the loading-carriage for

giving a start thereto in the backward or rearward direction from the gun-breech, so that the cam-rib will act on the carriage to preliminarily withdraw the exploded shell from the gun-breech, as will hereinafter more fully appear. The master-gear 58 is furthermore provided with a series of teeth constituting a gear-segment 66, said segment being located on the opposite face of the gear from the cam-rib 65 and disposed out of the plane of the segment 61, which actuates the loading-carriage. The segment 66 is formed on the master-gear in the interval or space between the ends of the loading-carriage segment 61, and this segment 61 has a greater number of teeth than the segment 66 for the feed-cylinder-operating carriage. The loading-carriage travels a greater distance toward and from the gun-breech than the feed-cylinder-operating carriage, and it is therefore necessary to increase the number of teeth of the segment 61 as compared with the teeth forming the segment 66, whereby the feed-cylinder-operating carriage is moved a short distance as compared with the travel of the loading-carriage. The face of the master-gear opposite the segment 66 is formed with a series of bevel gear-teeth 67, constituting a bevel gear-segment, which meshes with the corresponding segment 56 on the ring or sleeve 47, and at the ends of the bevel gear-segment 67 are the shoulders 68 69, which are arranged to coact with the lugs 56^a on the sleeve or ring 47. In the rotation of the master-gear in one direction the shoulder 68 of its bevel gear-segment 67 impinges against one of the lugs 56^a on the ring or sleeve 47 to move the latter into a position for the bevel gear-segment 56 of said sleeve to mesh with the bevel gear-segment 67 on the master-gear, and thus the master-gear is caused to mesh with and rotate the ring or sleeve a proper distance for adjusting the breech-block in one direction. On the reverse rotation of the master-gear the shoulder 69 of its bevel gear-segment impinges against the other lug 56^a on the sleeve, and thus the gear-segment 56 on the sleeve is moved to a position for proper engagement with the gear-segment 67 of the master-gear when the latter is driven in either direction and the parts coact to prevent stripping of the gear-teeth.

The two slidable carriages of my improved gun mechanism are disposed below and contiguous to the master-gear 58, and to properly support the slidable carriages in operative relation to this master-gear I employ the upper and lower guideways 70 71, which are fast with the main frame or housing 33, as clearly shown by the drawings. The guideways are parallel to each other and disposed in different horizontal planes for presenting the two carriages in proper relation to the master-gear for the racks on said carriages to mesh with the gear-segments 61 66.

The loading-carriage 72 is represented in detail by Fig. 14, and it is shown in several other figures of the drawings, notably Figs. 4 to 8, inclusive. This loading-carriage is cast or otherwise formed, preferably, of a single piece of metal, although the detailed construction is not essential, and said carriage is fitted in the lower guideway 71 of the frame or housing 33. One of the side rails of this loading-carriage is formed with a series of gear-teeth forming a rack 73, and at the ends of the rack are lugs 74, which are to be engaged by the shoulders 63 64 on the master-gear for the purpose of moving the carriage 72 to a position where the gear-segment 61 will properly engage with the teeth of the rack 73. To the carriage is fixed a vertical post 75, and on the upper end of this post is a horizontal bed 76. The bed and post may be cast in a single piece, and the post may have a foot-plate by which it is fixed firmly to the carriage in proper alinement with the bore of the gun. In one edge of the horizontal bed 76 a notch 77 is formed in a position to receive the cam-rib 65 on the master-gear, and in one position of the master-gear the segment 61 thereof is free from engagement with the rack 73 on the loading-carriage. Before the master-gear is disengaged from the rack of the loading-carriage one end of the cam-rib enters the notch 77, and after the charge shall have been exploded this cam-rib 65 on the rotation of the master-gear impinges against one wall of the notch 77 in order to retract the carriage a limited distance away from the breech, after which the gear-segment 61 meshes with the rack 73 for the continued rearward movement of the loading-carriage. This organization of parts is especially advantageous in view of the fact that after the charge shall have been exploded the shell becomes partly wedged in the gun-breech by reason of expansion of the shell, and to extract this expanded and wedged shell from the breech by the intermeshing of the gear 61 with the teeth of the rack would impose considerable strain on the two series of teeth, which would have a tendency to injure or strip the teeth. I overcome this objectionable tendency by the arrangement of the cam-rib 65 on the master-gear in a manner to start the carriage 72 in its backward movement, so that the extractor will loosen the expanded shell in the breech, and, as before indicated, the full rearward movement of the carriage with the extractor and the shell away from the breech is effected by the engagement of the gear-segment 61 of the master-gear with the rack 73 on the carriage. The horizontal bed 76 on the post of the loading-carriage is provided on its upper face with transverse parallel guide-flanges 78 79, and the front flange 79 is provided with a curved upper edge 79^a, which is arranged to ride against a guide-plate that is disposed opposite the revoluble feed-cylinder for the purpose of preventing the ammunition charge from having a tendency to drop out of the feed-cylinder chamber on the rotation of the revoluble feed-cylinder, as will presently appear. The bed 76 of the loading-

carriage supports the firing-bolt 80. This bolt is fitted loosely in and guided by the front flange 79, and at its rear end said bolt is provided with a transverse head 81, to which are secured the guide-stems 82, slidably fitted in the guide-flange 78 at the rear end of the bed 76. It will thus be seen that the firing-bolt is guided by the flanges 78 79 for reciprocating movement or play on the bed of the loading-carriage, and this firing-bolt is capable of movement or play independently of the movement of the loading-carriage itself, whereby the firing-bolt may be set and released when the loading-carriage is stationary at the breech of the gun. The firing-bolt is forcibly impelled in one direction by the coiled impelling-springs 83, which are fitted loosely on the guide-stems of said firing-bolt and are seated against the bolt-head 81 and the rear guide-flange 78. When the firing-bolt is set by engagement with the sear of the firing mechanism, the impelling-springs 83 are compressed between the bolt-head and the flange 78, and on the release of the firing-bolt to actuate the firing-pin within the breech-block the shock or jar on the bed and loading-carriage due to the impact of the parts is cushioned by the employment of coiled cushioned springs 84, which are fitted on the extended ends of the guide-stems 82, said cushion-springs being held in place by the key-pins 85 and seated against the guide-flange 78. (See Fig. 14.)

The bed 76 of the loading-carriage also carries the extractor device by which the shell of the exploded ammunition charge is retracted from the gun-breech. As shown by the drawings, the extractor consists of two members 86 87, which are disposed below the bed 76 and have their ends extended beyond opposite ends of the bed. The extractor members are arranged to cross or overlap each other, and they are pivotally connected together and to the bed by a single vertical pivotal bolt 88, whereby the front working ends of the extractor are made to move in opposite directions simultaneously. These front ends of the extractor members are notched, as at 89, to properly engage with the rim or flange on the shell of the ammunition charge, and the rear ends of the members are inclined, as at 90, (see Fig. 14,) in order that the extractor members may ride against the spreading stud 91, which is fixed to the frame or housing 33 in the path of the extractor. The members of the extractor are normally drawn together at their front ends by means of a connecting-spring 92, and the extractor is thus held in a position by the spring for its notched front ends to engage with the shell of the charge. On the forward movement of the carriage the ammunition charge is pushed or forced from the feed-cylinder chamber into the breech by means of a horizontal pusher-arm 93, which is fastened securely to the bed 76 and occupies a position below the extractor and in a plane between the movable members 86 87 of said extractor. The pusher-arm 93 extends beyond the front end of the bed 76, and it is provided with a notch 94 to fit the lower edge of the shell on the ammunition charge, and in the forward movement of the loading-carriage this pusher-arm 93 impinges against the closed butt-end of the charge in a manner to force the latter from the feed-cylinder into the breech.

As the loading-carriage approaches the limit of its rearward movement under the rotary action of the master-gear the inclined heels 90 of the extractor impinge against the spreading stud 91, which moves the extractor members on their pivots against the contractile energy of the spring 92, thereby spreading the front ends of the extractor members to release the exploded shell, which is gripped by said notched front ends. The exploded shell is adapted to be drawn from the gun-breech by the extractor on the rearward movement of the carriage, so that the shell will be introduced or deposited in the chamber of the feed-cylinder, from which it was delivered on the previous forward movement of the carriage, and as the extractor is released from the exploded shell by the time the carriage attains the limit of its rearward movement the shell may be discharged from the gun when the feed-cylinder rotates to present another ammunition charge into position for loading into the gun-breech. On the rotation of the feed-cylinder to present a fresh ammunition charge in line with the breech and the pusher of the loading-carriage the latter is advanced toward the gun-breech by the rotation of the master-gear in the proper direction, and as the carriage moves forward the heels of the extractor members are withdrawn from the spreading stud. At this period the extractor members clasp or fit the rim of the shell and the notched end 94 of the pusher-arm fits the shell. As the carriage continues to advance the charge is pushed or forced from the chamber of the magazine into the gun-breech, and the continued movement of the carriage causes the members of the extractor to enter the radial grooves 36 36ª of the breech and the pusher-arm to enter the groove 37 of said breech. The carriage now comes to a period of rest by the gear-segment 61, being free from engagement with the rack 73 of said carriage, and the master-gear through its bevel gear-segment 67 rotates the ring or sleeve 47 to make the eccentric arm 51 act on the breech-block to lower the latter across the gun-breech. The curved face of the breech-block impinges against the heel of the shell to force the charge home into the breech, and during the operation of exploding the charge the extractor members remain in engagement with the shell of said charge, so as to be in a position to extract the shell when the carriage is moved rearwardly, first, by the action of the cam-rib 65 on the notched bed-

plate, and, second, by the gear-segment 61, meshing with the rack 73 of the carriage, all as hereinbefore indicated.

The loading-carriage 72 also carries the means by which an oscillating feeder is actuated, said feeder being in operative relation to the revoluble feed-cylinder when the gun is constructed for rapid firing. This means for actuating the oscillating feeder is embodied in the form of a rod 95, which is disposed at one side of the firing-bolt and the extractor. This rod occupies an inclined position with relation to the horizontal plane of the loading-carriage 72, and said rod is secured detachably but firmly in place near one of the side bars of said carriage 72, as indicated by dotted lines in Fig. 14 and by full lines in Figs. 9 and 10.

I will now proceed to describe the revoluble feed-cylinder, which is disposed in operative relation to the gun-breech and the loading-carriage, and this feed-cylinder is actuated or rotated by a step-by-step feed mechanism which insures the presentation of the ammunition charges successively in line with the bore of the gun, the said feed-cylinder being locked in the periods between the rotation on its axis for the purpose of holding the feed-cylinder stationary during the introduction of the charge into the gun, the firing of the charge, and the extraction of the exploded shell.

It will be recalled from the preceding description that the rearward movement of the loading-carriage serves to withdraw the shell of the exploded charge from the breech, and said shell is deposited in the chamber of the feed-cylinder from which it was taken for introduction into the breech, whereby on the next step in the rotation of the revoluble feed-cylinder the exploded shell is discharged from one chamber of said feed-cylinder, while a fresh ammunition charge is being brought into position for introduction into the gun-breech. The revoluble feed-cylinder is fast with a horizontal shaft 97, which is arranged longitudinally with respect to the gun and at one side of the axis of the bore thereof, so that the chambers of said feed-cylinder will be brought into axial alinement with the gun-bore to properly position the ammunition charges for introduction into the breech. One end of the feed-cylinder shaft 97 is journaled in a bearing provided by a plate or lug 98 on the gun-breech, (see Figs. 16 and 17,) and the other end of said feed-cylinder shaft is mounted in a bearing at the closed rear end of the main frame 33. The feed-cylinder 96 is cylindrical in form, and it is constructed with a series of longitudinal chambers 100. In the embodiment of the invention represented by the drawings, more particularly by Figs. 10 and 15, the feed-cylinder is shown as having a series of four chambers, each of which opens at one side through the cylindrical surface of the feed-cylinder and is open at both ends thereof. The ammunition charges are introduced successively into the chambers of the feed-cylinder by depositing the charges laterally in the chambers 100 on the successive steps in the rotation of said feed-cylinder, and these charges are prevented from endwise movement within the feed-cylinder chambers by detaining-flanges 101 at the ends thereof. To accommodate one member of the extractor which is carried by the loading-carriage, each chamber 100 of the revoluble feed-cylinder is provided in the wall thereof with a longitudinal groove 102, that extends the full length of the feed-cylinder and opens through the ends of the same, and in a similar manner the bottom side of each feed-cylinder chamber 100 is formed with a longitudinal groove 103, adapted to receive the pusher-arm 93 on the loading-carriage. The revoluble feed-cylinder is disposed in close relation to the gun-breech for its chambers 100 to aline successively therewith, and when the feed-cylinder is brought to rest the grooves 102 103 are alined successively with one extractor member and the pusher-arm on the bed of the loading-carriage, whereby as the carriage is advanced the extractor and the pusher-arm are adapted to travel through the grooves of said feed-cylinder in order that the extractor may engage with the charge and the pusher may impel the charge endwise from the feed-cylinder chamber into the gun-breech. The feed-cylinder is held or locked in place during the loading operation, which is effected on the forward movement of the carriage, and said feed-cylinder also remains in the stationary locked position while the charge is being fired and the shell is extracted; but on the completion of the rearward movement of this loading-carriage the extractor is released from the exploded shell, and said extractor and the pusher-arm are moved far enough to clear the grooves 102 103 of the feed-cylinder chamber, thus making the loading mechanism free from the feed-cylinder, so that the latter may rotate on its axis one step for discharging the empty shell from one chamber and presenting a fresh ammunition charge in another chamber into proper loading position to the gun-breech. The ammunition charge when deposited in the longitudinal chamber of the feed-cylinder is not gripped or held in place by clamping devices, and when the feed-cylinder is rotated the charge may have a tendency to roll out of the chamber, particularly when the gun is working at high speed. To overcome this tendency, I provide each chamber of the feed-cylinder with a longitudinal detent-flange 104, which is disposed at one side of the chamber near the line where it opens through the cylindrical surface of the feed-cylinder. To furthermore limit any tendency of the charge to fly out of the feed-cylinder chamber, a detent-plate 150 is arranged contiguous to the sear and the firing mechanism. (See Figs. 4 and 5.) This detaining-plate is disposed alongside of the feed-cylinder above the path

of the bed on the loading-carriage, and said detaining-plate is pivoted to the auxiliary frame, presently described, by means of a bolt 151. The detaining-plate 150 has its lower edge in the path of the curved upper edge 79ª on the front flange 79 of the bed on the loading-carriage, and as the carriage is advanced to load the ammunition charge from the feed-cylinder into the gun-breech this detaining-plate 150 is raised by the flange 79 in order that the plate may not lie in the path of the loading-carriage bed or any of the devices thereon.

I will now proceed to describe the feed mechanism by which the revoluble feed-cylinder is rotated by a step-by-step feed, and this feed-controller mechanism may be said to consist of two important elements—to wit, a cam-slotted cylinder 105, forming the feed-controller proper, and a reciprocating carriage 110, said carriage being actuated by the master-gear 58 and serving to rotate the cam-slotted cylinder periodically. The feed-controller 105 is fastened firmly to the shaft 97 of the revoluble feed-cylinder at one side of the latter, and said feed-controller is elongated and disposed lengthwise of the shaft, so that the axis of the feed-cylinder and the feed-controller 105 is formed by a common shaft. The feed-controller is peculiarly constructed by forming a series of straight longitudinal grooves 106 and a like series of spiral grooves 107, which join or connect the straight grooves 106, thus giving to the surface of the feed-controller the peculiar appearance represented by Figs. 2, 3, and 15. The longitudinal grooves 106 are parallel to each other and spaced on the surface of the feed-controller at equal distances to correspond with the spacing of the chambers 100 in the revoluble feed-cylinder; but the spiral grooves 107 are cut in the surface of the feed-controller in the intervals between the longitudinal grooves. Each spiral groove opens into one longitudinal groove near that end of the feed-controller contiguous to the feed-cylinder; but the opposite end of the spiral groove connects with the adjacent longitudinal groove at or near the opposite end of the feed-controller 105. The end of the slot at the end of the feed-controller contiguous to the magazine is the entrance-point of a feed pin or spindle into the spiral groove, and this entrance of the spiral groove is deeper than the end of the longitudinal groove with which it communicates, so as to form an abrupt shoulder 108 between the entrance end of the spiral groove and the longitudinal slot with which it communicates. The spiral groove decreases in depth from the shoulder 108 toward its opposite end, where it communicates with the next longitudinal groove, and this decrease in the depth of the spiral groove from the shoulder 108 provides a shoulder 109 between the delivery end of the spiral groove and the longitudinal groove, into which said delivery end opens or communicates. This formation of the feed-controller with longitudinal and spiral grooves and the taper in the depth of the spiral grooves produces a construction which insures the rotation of the feed-controller under the reciprocating play of the feed pin or spindle, which is carried by the feed-cylinder-operating carriage 110. This feed-cylinder-operating carriage is slidably fitted in the upper guideway 70 of the main frame or housing to travel in a rectilinear path under the impelling action of the gear-segment 66 of the master-gear 58. The feed-cylinder-operating carriage 110 is represented in detail by Fig. 13 of the drawings, and one end of this carriage is open or unconnected, while the other end has the side bars united by a cross-piece, all of the parts of the carriage being preferably cast in a single piece. The side bar of said carriage 110, which lies below and in the vertical plane of the master-gear 58, is provided in its upper face with a series of teeth forming a gear-rack 111, and with this rack is adapted to mesh the teeth 66 on the master-gear for the purpose of moving the carriage endwise in a rectilinear path below the loading-carriage and wholly independent of the latter. On the cross-piece of the carriage 110 is erected a hollow or tubular post 112, (see Figs. 9 and 13,) and in this hollow post is slidably fitted a spring-controlled feed pin or spindle 113, the upper end of which is normally projected by this spring into engagement with the grooved feed-controller 105. It will be understood that on the rearward movement of the loading-carriage to a position behind and free from the revoluble cylinder the master-gear is moved to a position for its gear-segment 66 to mesh with the rack 111 on the carriage 110. Assuming that the feed-carriage 110 is in the advanced position shown by Figs. 7 and 8 and the feed pin or spindle 113 is in one of the straight grooves 106 at the forward end of the feed-cylinder 105, the engagement of the master-gear segment 66 with the rack 111 will move the feed-carriage in a rearward direction. The spring-pressed pin or spindle 113 is carried by or movable with the carriage 110 in a rectilinear path, and as the pin travels in a rearward direction with said carriage it rides against the shoulder 108 of the cam-slotted feed-controller 105, thus partly turning the feed-controller at the beginning of the rearward movement of the feed-cylinder-operating carriage. As the carriage continues to travel in the backward direction the pin or spindle 113 travels in one of the spiral grooves 107, and the feed-controller is thus turned on its axis to correspondingly actuate the shaft 97 and the feed-cylinder 96. As the carriage 110 approaches the limit of its rearward movement the spindle or pin 113 passes from the spiral groove 107 into the next longitudinal groove, and during the travel of the spindle or pin 113 in the spiral groove the pin is moved endwise in its post 112 to adapt itself to the taper or decrease in the depth of the spiral groove. At

the instant the pin reaches the next longitudinal groove in the feed-controller its spring recoils to suddenly impel the spindle into the longitudinal groove and past the shoulder 109, and thus the feed-controller is given a quarter-turn by the reciprocating movement of the carriage 110 in a backward direction, whereby the feed-cylinder is rotated one step to present a fresh charge of ammunition into alinement with the gun-breech. On the forward movement of the loading-carriage, due to the reversal of the master-gear by the driving mechanism, the gear-segment 66 of said master-gear meshes with the rack on the feed-cylinder-operating carriage 110 to move the latter in a forward direction for its full travel; but this forward movement of the feed-cylinder-operating carriage and the spring-pressed pin or spindle 13 thereon does not affect the cam-slotted feed-controller 105, because the pin or spindle 113 travels in the straight longitudinal groove of the cylinder, said pin riding past the abrupt shoulder 109 from one end of the straight groove, so as to position the spindle at the forward end of the straight groove and in advance of the shoulder 108, which leads to the next spiral groove 107. It will therefore be understood that the feed-carriage is actuated by the master-gear, and the pin or spindle 113 of said carriage serves to turn the feed-controller 105 a quarter-turn, and this motion of the feed-controller is communicated to the feed-cylinder; but the feed-controller and the feed-cylinder remain at rest while the loading-carriage is operated from the master-gear, because the segment 66 of said master-gear which actuates the feed-cylinder-operating carriage is formed on said master-gear in the interval between the segment 61 thereof that controls the loading-carriage. As the loading-carriage pursues its rectilinear path to move the charge from the feed-cylinder into the gun-breech and to extract the exploded shell from said breech and deposit said shell into the feed-cylinder the latter and the feed-controller remain at rest, because the master-gear does not mesh with the rack on the feed-cylinder-operating carriage; but when the loading-carriage comes to a period of rest the master-gear actuates the feed-carriage for the operation of the feed-controller and the feed-cylinder, and thus the two carriages 72 110 are reciprocated alternately by the master-gear.

I will now proceed to describe the oscillating feeder which is employed in conjunction with the step-by-step feed-cylinder when the invention is embodied as a rapid or quick firing gun; but it will be understood that in guns of large caliber the feeder mechanism for the feed-cylinder is not employed.

Above the path of the two carriages and the devices associated therewith I employ a supplementary or auxiliary frame 116, which is fastened securely to and within the main frame or housing 33, and in passing I may remark that this supplementary frame is removable readily from the main housing in order to permit ready access to the working parts of the gun for inspecting or repairing the latter. This supplementary frame supports the oscillating feeder 117 and nearly all the elements of the firing mechanism. The feeder 117 is shown more clearly by Figs. 2, 9, 10, and 26, and said feeder is disposed immediately above the revoluble feed-cylinder and in a position to deposit the ammunition charge into either of the chambers 100. The feeder is provided with a curved plate or receptacle 118, which is fast with a cross-bar, serving the purpose of the support for said receptacle, and at its end said feeder has the trunnions 119, which are mounted to turn freely in suitable bearings of the supplementary frame 116. The feeder is thus hung on a horizontal axis to turn in a vertical plane, and the movement of this feeder is timed or controlled to rock in the intervals between the step-by-step feed given to the revoluble feed-cylinder, whereby the charge may be placed in the feeder and deposited by the latter into a chamber of the feed-cylinder when the latter is at rest. At one end this pivoted feeder 117 is provided with a crank-arm 120, which is fast with one of the trunnions 119, (see Fig. 26,) and to this crank-arm is pivoted the upper end of a vertically-disposed pitman 121, which is slidably fitted in a suitable guide or guides 121^a, fast to the main frame or housing 33. The lower end of this vertically-disposed pitman 121 is provided with an eye 122 to slidably receive the inclined rod 95 on the reciprocating carriage 72. (See Figs. 9 and 10.) While the feed-cylinder, its feed-controller, and the feed-cylinder-operating carriage 110 are at rest, the loading-carriage 72 is reciprocated by the driving-gear, and as the loading-carriage travels back and forth the inclined rod 95 thereof travels through the eye of the pitman 121, whereby the pitman is reciprocated vertically on the to-and-fro travel of the loading-carriage. The elevation of this pitman by the action of the inclined rod 95 turns the feeder 117 on its horizontal axis in a position to present its curved receptacle 118 opposite the feed mouth or slot in the casing or housing 33, whereby the ammunition charge may be deposited into the oscillating feeder. As the carriage moves in a backward direction the inclined rod 95 depresses the pitman 121 to reverse the position of the oscillating feeder, and as the feed-cylinder is stationary during the oscillation of this feeder the charge from the feeder is deposited with precision and accuracy in the chamber of said feed-cylinder. It is therefore apparent that the oscillating feeder works in unison with the loading-carriage and during the period when the feed-cylinder and its associated parts are at rest, but in the rotation of the feed-cylinder, under the impelling action of the cam-slotted

feed-controller and the feed-cylinder-operating carriage, the loading-carriage and the oscillating feeder remain stationary.

I will now proceed to describe the firing mechanism by which the charge loaded into the gun-breech may be exploded, and in this connection I desire to call attention especially to the fact that this firing mechanism is adapted to be operated automatically when the gun is adjusted for a continuous rapid firing, or the firing mechanism may be controlled or operated by hand. One element of the firing mechanism is a cam-plate 126. (Shown more clearly by Figs. 23, 24, and 25 and also indicated in several of the other general figures of the drawings.) This cam-plate is capable of a pivotal swinging movement under all conditions of service of the firing mechanism; but it is mounted or supported on a slidable plate that is controlled by the manually-operative rod, to which the lanyard may be attached. The cam-plate 126 is supported contiguous to and over the revoluble ring or sleeve 47, so as to coact with the cam-lug 57 thereon, and this cam-plate 126 is pivoted at or near one corner or edge thereof on a pivotal pin 127, which is attached to the slidable carrier-plate 123. This slidable carrier-plate is arranged alongside of and contiguous to one of the bars of the supplementary frame 116, and at a point intermediate its length this carrier-plate is offset or bent at 123^a to provide a space between the offset of the plate and the frame-bar 116. At its ends the carrier-plate is provided with longitudinal slots 124, which receive the fastening-pins 125, and these pins are secured firmly to the frame 116 to support the carrier-plate slidably thereon. This carrier-plate is capable of reciprocating play in a rectilinear path on the frame 116 and in a direction transversely across or at right angles to the axis of the gun-bore, and said carrier-plate has the pivot 127 of the cam-plate attached directly thereto. It will be understood that the cam-plate 126 is fitted in the space provided between the offset 123^a of the carrier-plate and the frame 116, and this cam-plate is adapted to move or travel with the carrier-plate 123 when the latter is adjusted or moved by the operation of the lanyard-rod. The pivotal cam-plate is therefore capable of traveling movement with the carrier-plate and of a pivotal movement on its pin 127 independently of the carrier-plate. The cam-plate is provided with a curved lower edge 128, which is adapted to ride upon the cam-lug 57 of the ring or sleeve 47, and at one end this cam-plate 126 is extended to form a nose 129, which is adapted to rest upon the carrier-plate 123 at the point where the offset 123^a is formed therein, whereby the cam-plate may rest on the carrier-plate to be supported at two points thereby, one of these points being formed by the pivot 127 and the other point by the nose 129, resting on the carrier-plate. The cam-plate 126 is furthermore provided with a longitudinal slot 130, in which is fitted a stud on an arm of the rock-shaft 131, as will presently appear. This rock-shaft 131 is arranged above and with its axis at right angles to the slidable carrier-plate 123 and the cam-plate 126, and said rock-shaft is journaled in suitable bearings 132 on the frame 116. The rock-shaft is disposed above and in line with the travel of the loading-carriage 72, and at one end said rock-shaft has an arm 133, fast therewith, said arm extending alongside of the cam-plate 126 and provided with a stud 134, which is fitted in the slot 130 of the cam-plate 126. The other end of the rock-shaft is provided with a similar arm 135, which is fast with said shaft to rock or turn therewith, and to this arm 135 is pivoted the upper end of a link 136. This link depends from the rock-shaft and its arm a suitable distance to have its lower end pivoted to a sear 137, and said sear is guided for movement in a vertical rectilinear path by guide flanges or lugs 138, which are disposed on the frame 116 immediately over the path of the firing-bolt, which is carried by the bed on the loading-carriage. A spring 137^a (see Figs. 4 and 5) acts on the sear to normally depress the lower end thereof into the path of the head 81 of the firing-bolt 80, and the cam-plate and the spring 137^a hold the sear 137 in its depressed position, so that it is locked on the forward movement of the loading-carriage and the firing-bolt therewith, whereby the sear is fitted to engage with the head of the firing-bolt as the carriage is moved toward the breech, and said sear holds the firing-bolt rearwardly to compress its impelling-springs, and thereby set the firing-bolt in condition to be forcibly impelled in a forward direction by its impelling-springs on the release of the sear from the bolt-head 81.

The carrier-plate 123 is provided at one end with a flange 139, to which is firmly secured a stud 140. The lanyard-rod 141 is disposed at one side of the main frame or housing 33, longitudinally thereof, and said lanyard-rod is guided in suitable bearings or supports within said frame or housing. (See Fig. 9.) The inner end of the lanyard-rod is in the form of a plate, in which is produced an inclined or cam slot 142, that receives the stud 140 on the end of the carrier-plate 123, and when the lanyard-rod is moved in one direction this cam-slot 142 imparts movement in a rectilinear path and in one direction to the carrier-plate 123, said plate having the cam-plate 126 pivoted thereon. The lanyard-rod 141 is furthermore provided with a collar 143, and in one side of this collar is cut a notch which produces an abrupt shoulder 144. (See Fig. 2.) A coiled impelling-spring 145 is fitted loosely on the lanyard-rod, at a point in rear of the collar 143 thereon, and one end of this spring is seated against the collar, while its opposite end bears against a part of the frame or housing 33, (see Fig. 9,) whereby the spring serves to impel the lanyard-rod in a forward direction and to make the cam-slot

of the rod move the stud 140 to the inner end of said slot 142, whereby the carrier-plate is positioned for the edge 128 of the cam-plate 126 to be free from the cam-lug 57 on the ring or sleeve 47. The rear end of the lanyard-rod 141 is extended or prolonged beyond the frame or housing 33, and said extended end of the rod is provided with an eye 146 to provide for the convenient attachment of the lanyard to the rod 141. A locking-lever 147 is disposed in an upright position adjacent to the shouldered collar 143 on the lanyard-rod, and this lever passes through a slotted detent-plate 148, which is fixed firmly to the main frame or housing 33, the slot in said plate being inclined to provide an abrupt shoulder 149. This locking-lever is disposed in a position to engage with the shoulder 144 of the spring-collar, and when the lever is thrown in a forward direction it does not control or influence the movement of the lanyard-rod, which is thus free to be impelled in a forward direction by its spring. With the lever in this position the lanyard-rod is adapted to actuate the firing mechanism by hand; but when the lever is drawn rearwardly to engage with the shoulder 149 of the slotted detent-plate it impinges against the shoulder of the collar 144 and moves the lanyard-rod in a rearward direction to embrace its spring 145. The lever is thus adapted to lock the lanyard-rod in its rearmost position, and the cam-slot 142 of said rod acts on the stud 140 to move the carrier-plate 123 across the gun mechanism to the position shown by Fig. 23. The firing mechanism thus has its cam-plate 126 disposed in the path of the cam-lug 57 on the ring or sleeve 47, and the firing mechanism is adapted for service automatically by the cam-lug 57 in the oscillation of the ring or sleeve 47, which is actuated by the master-gear. In the movement of the ring or sleeve 47 to lower the breech-block the lug 57 of said ring or sleeve rides against the curved edge 128 of the cam-plate after the breech-block has been fully lowered and its curved face acting against the heel of the ammunition charge to force the latter home in the breech, and as the ring or sleeve completes its rotation the cam-plate is lifted by the cam-lug 57, said cam-plate turning on its pivot 127 and raising the plate for its slot 130 to assume an inclined position. This elevation of the cam-plate moves the arm 123 in an upward direction to rock the shaft 131 in its bearings and cause its arm 135 to lift the sear 137. As the breech-block is not lowered until the loading-carriage shall have been advanced to introduce the charge into the breech and as the firing-bolt is forced rearwardly by the sear to compress the springs on the forward movement of the loading-carriage, it is obvious that the firing-bolt is set in its working position previous to the period when the cam-lug 57 on the ring or sleeve lifts the cam-plate to raise the sear, and this sear is thus elevated out of the path of the head 81 on the firing-bolt, whereby the latter is freed from restraint and the impelling-springs thereof recoil to forcibly throw the firing-bolt into contact with the firing-pin, which is carried by the breech-block, thus exploding the charge. After the charge shall have been exploded the master-gear is reversed by the reversing-clutch-driving mechanism to move the ring or sleeve 47 in the reverse direction for the purpose of lifting the breech-block and withdrawing the cam-lug 57 from engagement with the cam-plate 126. On the return travel of the loading-carriage and reversal of the ring or sleeve 47 the breech-block is lifted by the ring or sleeve, and the firing-bolt is moved with the loading-carriage rearwardly away from the sear and the revoluble feed-cylinder, and the spring 137[a] operates on the sear to turn the rock-shaft, thereby lowering the sear and the cam-plate 126 to their normal operative positions. The sear is thus interposed in the path of the firing-bolt on the loading-carriage, and the cam-plate is again lowered for its edge 128 to be in the path of the cam-lug 57 of the adjusting-ring, the descent of the cam-plate 126 causing its nose 129 to rest on the carrier-plate 123, which is held in a stationary or immovable position by the lanyard-rod being locked with the lever 147. The firing mechanism is thus actuated automatically by the cam-lug of the adjusting-ring which controls the breech-block, and the period of releasing of the bolt 80 is controlled by this cam-lug until the breech-block shall have been lowered and locked in place by the ring and the firing-bolt shall have been set by engagement with the sear. The firing mechanism is also adapted for operation or control manually, and to effect this change in the mode of service of said firing mechanism it is only necessary to adjust the lever 147 in the slotted detent-plate to clear the shoulder 148 of said plate. This adjustment of the lever permits the spring 145 to impel the lanyard-rod 141 in a forward direction, and the cam-slot 142 of said rod moves the carrier-plate 123 to the position shown by full lines in Fig. 24, whereby the cam-plate 126 is carried with the plate 123 to a position at one side of the path of the lug 57 on the ring or sleeve 47 to permit said ring or sleeve to complete its movement and lower and lock the breech-block without the lug 57 impinging against the edge 128 of the cam-plate. The lug 57, however, is contiguous to the edge of the cam-plate 126 for the latter to ride upon the lug on the operation of the lanyard-rod. After the carriage 72 shall have been moved to a position where the sear engages with the head of the firing-bolt and the ring or sleeve 47 is adjusted to lower the breech-block and lock the same across the breech the operator pulls the lanyard-rod through the lanyard in a rearward direction, thereby compressing the spring 145. This rearward movement of the lanyard-rod causes the cam-slot 142 to impel the carrier-plate 123 in a rectilinear path across the gun-

breech, and as the cam-plate 126 is pivoted on this carrier-plate the edge 128 of said cam-plate rides against the lug 57 of the ring or sleeve. As the carrier-plate travels the cam-plate is turned by the lug 57 to the elevated position, where its slot 130 is inclined, and thus the arm 133 is lifted in order to rock the shaft 131, which through the described connections lifts the sear 137 from engagement with the head of the firing-bolt, whereby the bolt is released to act against the firing-pin, which explodes the charge in the gun-breech.

When the revoluble feed-cylinder is at rest, it is locked firmly in position against accidental movement by two sets of devices, one of which devices is a spring-controlled brake mechanism and the other locking-plates on the feed-carriage 110. The brake mechanism is operatively applied to the feed-cylinder shaft 97 near the end where it is journaled in the frame or casing 33, and said brake mechanism consists of a shoe 152, that is supported between a part of the main frame or casing 33 and a guide-block 153, which is fastened firmly to the casing. The shoe bears or presses on the feed-cylinder shaft 97, and it is held firmly in contact therewith by a pressure-spring 154, attached to the main frame or casing 33. (See Fig. 27.) The positive locking devices are on the feed-cylinder-operating carriage 110. One locking device is an arm 114, attached to the carriage 110 near the post of the spring-pressed feed finger or spindle 113, and the other positive locking device is a plate 115, which is attached to the carriage near the other end from the finger 114. When the feed-cylinder-operating carriage is moved rearwardly and the feed-cylinder is at rest, the plate 115 engages with the wall of one of the feed-cylinder chambers; but on the reversal of the feed-cylinder-operating carriage the finger 114 engages with the feed-cylinder at the opposite end thereof from the plate 115. It will be understood, however, that the plate and finger do not engage simultaneously with the feed-cylinder; but in the normal position of the feed-cylinder-operating carriage and the feed-cylinder the finger 114 engages with the latter to hold it in place.

I will now proceed to describe the reversing clutch-driving mechanism, by which the shaft 59 of the master-gear may be rotated first in one direction and then in the opposite direction in order to properly actuate the master-gear for the operation of the loading and feed-cylinder-operating carriages, and this driving mechanism is controllable to automatically throw the power-shaft out of gear with the master-gear shaft after the load shall have been deposited in the breech and the parts adjusted for operation to be fired by hand. The driving mechanism also serves to continuously operate the master-gear from which the several working parts of the gun mechanism are operated in unison and at proper intervals when the gun is adjusted for rapid and continuous firing. Certain of the working parts of this driving clutch mechanism are supported by a bearing-plate 156, which is fixed to the main frame or housing, on the outside thereof, near the trunnions of the gun, and the power-shaft is journaled in proper bearings 158 on a fixed bearing-bracket 155. This power-shaft may be provided with a crank 159 or its mechanical equivalent for coupling a power-transmitting appliance to the shaft 157 in order to drive the shaft by engine-power; but one end of the shaft 157 is extended or prolonged to receive a hand-crank 160, as indicated by dotted lines in Fig. 2, whereby the shaft 157 may be operated by hand-power when the engine-power is disconnected. The inner end of the shaft 157 is provided with a bevel gear-pinion 161, which meshes with a similar bevel gear-pinion 164 on one end of a tubular shaft 162^a, which is journaled in bearings 163 of the bearing-bracket 155. (See Figs. 1, 2, 3, 11, and 12.) The tubular shaft 162^a is disposed lengthwise on the outside of the main frame or housing 33, and this tubular shaft carries one member of a clutch mechanism. One clutch member 165 is fast with the tubular shaft 162^a; but the other clutch member 166 is keyed fast with a counter-shaft 162, which is fitted at one end in the tubular shaft, so as to be concentric therewith, and has its other end supported in a suitable bearing on the bearing-plate 156. The clutch member 166 is slidable on the counter-shaft 162 toward or from the clutch member 165 on the tubular shaft 162^a, which normally is in mesh with the power-shaft, whereby the two clutch members may be coupled or uncoupled to transmit the motion of the power-shaft through the tubular shaft to the counter-shaft or to permit the counter-shaft to remain at rest when the tubular shaft rotates with the power-shaft. The slidable clutch member 166 is provided with an annular groove 167 to receive the forked end of a shipping-arm 170, which is fast or integral with a shipping-plate 168, that is fitted in suitable guides 169 on the bearing-plate 156, whereby the shipping plate and arm may travel in a path parallel to the counter-shaft, and the clutch member 166 is movable with the shipping-arm into or out of engagement with the revoluble clutch member 165 on the tubular shaft.

171 designates a stub shaft or axle which is fast with the bearing-plate 156 at a point contiguous to the rear end of the counter-shaft 162, and between this counter-shaft and the master-gear shaft 59 are two trains of mutilated gears, which are driven continuously in opposite directions by the counter-shaft and which serve to periodically reverse the direction of rotation of the master-gear 58. One train of mutilated gears is indicated by the numerals 172 173, which are disposed on one side of the vertical axis of the longitudinal counter-shaft 162, and one member 172 of this train of mutilated gears is

fitted loosely or sleeved on the stub-shaft 171, while the other member 173 is fixed to the master-gear shaft 59, so as to rotate therewith. The gear member 172 is provided on one face thereof with a continuous series of bevel-gear teeth 174, and it is furthermore provided with a series of peripheral spur-gear teeth 175, at the ends of which are lugs 176. The other member 173 of the train of gears has a series of peripheral spur-gear teeth 177, at the ends of which are lugs 178, and on one face of this gear 173 is a cam-lug 179, which is adapted to actuate the clutch-shipping rod, as will hereinafter appear. The counter-shaft 162 is provided with a bevel gear-pinion 180, which is normally in mesh with the bevel-gear teeth 174 on the gear member 172 of the train of gears, and this gear member 172 is thus adapted to be rotated continuously in one direction from the counter-shaft. The other member 173 of the train of gears is not rotated continuously, but is turned at intervals only by having its teeth 177 mesh with the teeth 175 on the continuously-driven gear 172, and in the operation of these gears the lugs 176 of the gear member 172 are adapted to coact with the lugs 178 on the gear member 173 for the purpose of moving the gear member 173 into position for its teeth 177 to mesh with the teeth 175 on the gear member 172, thus overcoming any tendency of the gear-teeth to be stripped or injured by the action of the counter-shaft. The other train of mutilated gears is driven in an opposite direction to the train 172 173, and this second train of gears is indicated by the numerals 181 182, the gear 181 being mounted loosely or sleeved on the shaft or axle 171, directly opposite to the gear 172. The second train of mutilated gears 181 182 is disposed in a vertical plane on the opposite side of the axis of the counter-shaft from the first train of mutilated gears, and said second train of mutilated gears 181 182 form operative connections from the counter-shaft to the master-gear shaft to rotate the master-gear in an opposite direction and intermittently with the motion imparted thereto by the first train of gears 172 173. The member 182 of the second train of gears is fast with the master-gear shaft 59, and, as shown by Fig. 3, the gears 173 182 may be in a single piece with a common hub or sleeve which is adapted to be fixed to the shaft 59 by a screw-key or other suitable means of fastening. These gears 182 173 are actuated alternately by the gears 181 172, respectively, to rotate the master-gear in opposite directions alternately. The gear member 181 of the second train of gears has bevel-gear teeth 183, which mesh with the bevel gear-pinion 180 on the counter-shaft, and said gear member 181 is furthermore provided with peripheral spur-gear teeth 184, at the ends of which are the positioning-lugs 185. The other member 182 of the second mutilated train of gears has peripheral spur-gear teeth 186, adapted to mesh with the spur-gear teeth 184 of the gear member 181, and said gear member 182 has the lugs 187, which coact with the lugs 185 on the gear member 181 in order to position the gear 182 for its teeth to mesh with the spur-gear teeth 184 on the gear member 181. With the counter-shaft 162 rotating continuously in one direction the bevel-gear 180 rotates the gear members 172 181 of the two trains of mutilated gears continuously in the opposite directions, because said gear members 172 181 are disposed on opposite sides of the counter-shaft. With the gear members 172 173 of one train of gears in the position indicated by Fig. 11 and said gears rotating in the directions indicated by the arrows the lugs 176 of the gear member 172 engage with a lug 178 on the gear member 173 to move the last-named gear member 173 into position for its gear-teeth 177 to mesh with the gear-teeth 175 on the gear 172, and thus the gear member 173 is driven or rotated a half-turn from the gear member 172 to correspondingly turn the master-gear 58 for advancing the loading-carriage and actuating the several parts, as heretofore indicated. While the gear member 172 actuates the gear member 173 of the first train of gears, the gear member 182 of the two trains of gears is out of mesh with the gear member 181; but by the time the gear member 173 of the first train of gears shall have completed its movement the lugs 185 on the member 181 of the second train of gears engage with a shoulder 187 of the gear member 182 for the purpose of moving said gear member 182 into position for its teeth 186 to mesh with the teeth 184 on the gear member 181. The second train of gears rotates in the direction indicated by the full-lined arrows in Fig. 1 in order to turn the gear 182 in the opposite direction from the gear 173, and thus the master-gear is reversed and given a half-turn to retract the loading-carriage from the gun-breech. The clutch mechanism is adapted to be automatically thrown out of operation after the first train of gears 172 173 shall have moved the loading-carriage into position to set the firing-bolt subsequent to the introduction of the charge into the gun-breech and the closing of the breech-block; but this operation of the clutch is effected only when the gun is to be loaded and fired at intervals, the firing mechanism being controlled by hand. When the gun is to be loaded and fired automatically, the two trains of mutilated gears (indicated by 172 173 and 181 182, respectively) are operated automatically from the driving and counter shafts to reverse the rotation of the master-gear continuously, and this operation of the master-gear operates the loading and feed carriages of the firing mechanism to load, fire, extract, and reload the gun continuously. The slidable member 166 of the clutch is controlled through the shipping plate and arm by a shipping-rod 188, which is disposed in a substantially-horizontal position above the first train 172 173 of mutilated gears. This shipping-rod has its front end pivoted at

189 to the slidable shipping-plate 168, and on the lower edge of this shipping-rod, near the rear end thereof, is formed a shoulder 190, which is normally in the path of the cam 179 of the member 173 of the first train of gears. The shipping-rod is normally depressed for its shoulder to lie in the path of the cam-lug 179 and to impel the movable member 166 of the clutch into engagement with the rotary member 165 of said clutch by a spring-controlled pressure-rod 191, which is pivoted at 192 to a lug 193 on the upper edge of said shipping-rod 188. The rear end of this pivoted pressure-rod is slidably confined in a fixed guide 194, and on this rod is fitted a coiled spring 195, having its front end seated against a shoulder of the rod and its rear end pressing against the fixed guide 194, so as to impel the shipping-rod in a forward and downward direction.

An adjusting-lever 196 is disposed in a substantially-upright position adjacent to the rear end of the shipping-rod, and the upper end of this lever is fulcrumed at 197 to the frame or housing 33. The lower end of the lever is adapted to engage with either of three notches 199, 200, or 201 in the segment 198, which is fixed to the frame or housing 33, and to the lever 196 is connected a pawl 202, which is pivoted, as at 203, to the lever and is provided with a nose 204, adapted to fit in a notch 205 of the shipping-rod 188. The shipping-rod has the elongated notch 205, arranged to receive the nose of the pawl on said adjusting-lever in a manner to permit said rod to have a limited endwise movement or play without affecting the pawl or the lever or without being affected thereby; but when the lever is moved rearwardly in the segment the pawl is adapted to pull the shipping-rod endwise against the tension of its pressure-spring, and thereby move the clutch member 166 from the path of the clutch member 165. The pawl 202 is held normally in engagement with the notched end of the shipping-rod by the pressure-spring 206. The adjusting-lever 196 is provided with a lip 207, which rests on a setting-lever 208, which is fulcrumed at a point intermediate its length to the frame or housing, as at 209, and has its short arm normally fitted below and in engagement with the shipping-rod 188. The long arm of the lever is confined in a keeper 210, fastened to the frame or housing, that serves to confine the setting-lever in proper operative relation to the shipping-rod and the adjusting-lever.

The reversing clutch-driving mechanism is adapted to be controlled by the adjusting-lever 196 to adapt the gun mechanism for operation continuously and automatically to load, fire, and extract the shell of the exploded charge; or said mechanism may be controlled by the lever 196 to automatically throw the driving mechanism out of gear with the master-gear after the load shall have been introduced and the gun mechanism is adapted to have the firing mechanism discharged by hand; or said driving mechanism may be thrown entirely out of gear with the power-shaft to permit the latter to rotate continuously without affecting the driving mechanism by which the master-gear is propelled. With the adjusting-lever 196 moved to the rear end of the segment 198 and in engagement with the notch 201 therein the pawl 202 is turned rearwardly against the back wall of the notch 205 to drive the shipping-rod 188 in a rearward direction to compress the spring 195 and actuate the shipping plate and arm to move the clutch member 166 from the path of the clutch member 165, thus permitting the tubular shaft 162^a and the clutch member 165 to rotate continuously with the power-shaft without affecting the counter-shaft and the train of mutilated gears constituting the driving mechanism. With the adjusting-lever 196 shifted forward in the segment 198 to engage with the notch 200 therein the driving mechanism is adapted for service automatically to actuate the master-gear to propel the loading-carriage in order to introduce the charge into the gun and set the firing-bolt. With the loading-carriage in its rearward position (shown by Figs. 4 and 6) the lever 196 is in the position shown by Fig. 11, and the clutch member 166 engages with the clutch member 165 to rotate the counter-shaft from the driving-shaft. The first train of gears 172 is driven from the counter-shaft to rotate the master-gear in the direction indicated by the arrow in Fig. 6, and on this rotation of the train of gears 172 173 and the master-gear 58 the carriage is advanced to remove the charge from the feed-cylinder and introduce said charge into the breech. At the completion of the forward movement of the loading-carriage the cam 179 on the gear 173 of the first train of mutilated gears engages with the shoulder 190 on the lower edge of the shipping-rod 188 in order to retract the shipping-rod against the pressure of its spring 195, and thereby disengage the clutch member 166 from the clutch member 165, thus permitting the counter-shaft and the train of gears to come to a period of rest simultaneously with the closing of the breech-block and the setting of the firing-bolt. The driving-shaft may now rotate continuously without affecting the driving mechanism, and the attendant is thus able to deliberately sight the gun and discharge the ammunition charge by operating the lanyard-rod of the firing mechanism. Subsequent to the explosion of the charge the driving mechanism may be thrown into gear for operating the carriages in a manner to have the loading-carriage extract the exploded shell to make the feed-cylinder-operating carriage rotate the feed-cylinder one step and again advance the loading-carriage to introduce the ammunition charge from the feed-cylinder into the breech. This is effected through the agency of the setting-lever 208, which lifts the shipping-rod 188 on its pivotal connection

with the shipping-plate so that the shoulder 190 of the shipping-rod will be free from engagement with the cam-lug 179 of the gear member 173. This elevation of the shipping-rod permits the impelling-spring 195 to move the shipping-rod in a forward direction and thereby shift the clutch member 166 into engagement with the clutch member 165 and permit the counter-shaft to be rotated from the power-shaft. As the counter-shaft begins its rotation the second train of gears 181 182 are brought into mesh to rotate the master-gear 58 in the contrary direction to that in which it was driven by the first train of gears 172 173, and this master-gear in turn propels the loading-carriage to retract it from the breech to actuate the ring or sleeve 47 for lifting the breech-block and to propel the feed-cylinder-operating carriage, which through the cam-slotted feed-controller rotates the feed-cylinder. As the master-gear begins to move in the direction indicated by the arrow in Fig. 8 it first turns the ring or sleeve 47 on the gun-breech in order to lift the breech-block and open the way for the extraction of the exploded shell, and as the train of gears 181 182 continue to rotate the master-gear moves the loading-carriage 72 in a rearward direction for the extractor on said carriage to haul the exploded shell out of the breech and deposit the shell in the feed-cylinder chamber, from which it was taken when the gun was loaded, the extractor being released from the shell by the releasing-stud in the path thereof as the carriage reaches the limit of its rearward movement. As the loading-carriage comes to a period of rest the master-gear is propelled by the train of gears 181 182 to actuate the feed-cylinder-operating carriage that supports the feed pin or spindle in operative relation to the cam-slotted feed-controller for rotating the feed-cylinder one step, and this rotation of the feed-cylinder discharges the empty shell from one chamber and brings the ammunition charge in its other chamber into alinement with the gun-breech. At this period in the operation of the driving mechanism the member 181 of the second train of gears clears the teeth of the member 182, thus throwing the second train of gears out of operative relation to the master-gear, and at the same time the member 172 of the first train of gears engages with the member 173 to reverse the rotation of the master-gear 58 and impel the latter in the direction indicated by the arrow in Fig. 6, so as to again advance the loading-carriage to remove the charge from the feed-cylinder and force said charge into the gun-breech. The rotation of the master-gear in the direction indicated operates the ring or sleeve to lower the breech-block subsequent to the introduction of the charge, and thereby position the firing-pin in the path of the firing-bolt, which is set by the sear as the carriage completes its forward movement, and at this stage in the rotation of the gear 173 its cam-lug 179 impinges against the shoulder 190 on the shipping-rod for the purpose of moving said rod rearwardly and withdrawing the clutch member 166 from engagement with the clutch member 165, which is driven by the power-shaft. The driving mechanism is thus automatically thrown out of gear with the driving-shaft and comes to a period of rest; but before the driving mechanism ceases to operate the loading-carriage will have reached the limit of its forward movement, as indicated by Fig. 7, the breech-block will have been lowered in rear of the charge, and the firing-bolt will have been set by the sear in a position where it may be released by pulling on the lanyard to operate the firing mechanism manually. With the adjusting-lever 196 shifted into engagement with the first notch 199 of the segment 198 the driving mechanism is adapted for operation continuously from the power-shaft in order to automatically load, fire, and extract the empty shell, the parts working continuously and uninterruptedly, except by shifting the position of the lever 196. With the lever locked in the front notch 199 of the segment the clutch member 166 is held normally in engagement with the clutch member 165 by the pressure-spring 195, and the reversing-trains of mutilated gears are thus brought into service successively to rotate the master-gear alternately in opposite directions in the manner heretofore described, the cam 179 on the gear 173 of the first train of gears rotating past the shoulder 190 on the shipping-rod without influencing or touching the latter.

The top 211 of the casing or housing 33 is designed to be closed normally in order to protect the several working instrumentalities within said casing, and this top is provided with a feed throat or slot 212, which lies at one side of the housing or casing and in a position for the ammunition charges to be introduced into the oscillating feeder 117.

In order to indicate to the attendant stationed at the rear end of the gun the position of the several members of the clutch, I provide an indicator-rod 213, which is confined in guides 214 on the top of the housing. The front end of this indicator-rod 213 is pivoted to an upright lever 215, which is fulcrumed on the side of the frame or housing and has its lower end pivoted to the shipping-rod 188. (See Figs. 1, 11, and 12.) The forward movement of the shipping-rod to throw the clutch member 166 into gear with the tubular shaft will move the indicator-rod in a rearward direction; but when the clutch members become disengaged the indicator-rod will be drawn in a forward direction to notify the attendant of the position of the clutch.

The general operation may be described briefly as follows: Assuming that the gun is to be loaded, fired, and unloaded automatically and uninterruptedly, the adjusting-lever 196 is moved forward to the notch 199 in the segment 198 to the position shown by Fig. 1,

and the lip 207 of the lever 196 acts on the setting-lever 208 to lift the short arm of the lever, and thereby throw the shipping-rod 188 in an upward direction for the shoulder 190 on said rod to be out of the path of the cam-lug 179 on the gear 173. The spring 190 forces the rod 188 in a forward direction to hold the clutch member 166 normally in engagement with the clutch member 165, and the counter-shaft is driven continuously by the power-shaft. With the loading-carriage in the retracted position (shown by Figs. 2, 4, and 6) the breech-block is raised and the feed-cylinder has a charge in line with the gun-breech. Now as the counter-shaft begins to turn the train of gears 172 173 turns the master-gear 58 a half-turn in the direction shown by the arrow in Fig. 6 and the loading-carriage is advanced for the extractor and the pusher to engage the charge, and the charge is thus forced from the feed-cylinder into the breech. Before the master-gear 58 completes its turn in the direction indicated the cam-rib engages the notched bed to the loading-carriage and the ring or sleeve 47 is actuated by the master-gear to lower the breech-block in rear of the charge, as shown by Figs. 3, 5, and 7, thus bringing the firing-pin in line with the firing-bolt, which is set by the sear. As the ring or sleeve 47 completes its turn the cam-lug 57 thereof lifts the cam-plate 126 to move the rock-shaft and retract the sear from the firing-bolt 80 to permit the impelling-springs to forcibly throw the firing-bolt against the firing-pin, and thus explode the charge. At this period the first train of gears 172 173 are disengaged and the second train of gears 181 182 are brought into mesh to rotate the master-gear in the opposite direction, as indicated by the arrow in Fig. 8, so that the sleeve 47 will lift the breech-block for the plate 126 to return to position and the cam-rib of said gear acts on the bed of the carriage 72 to retract the carriage somewhat before the gear-segment 61 meshes with the rack of the loading-carriage, so that the extractor and loading-carriage are moved by a cam action to withdraw the expanded and wedged charge from the breech. The teeth 61 now mesh with the carriage-rack and the carriage is drawn back for the extractor to deposit the shell in the feed-cylinder, and as the extractor and pusher clear the feed-cylinder the gear-segment 66 of the master-gear engages the rack of the feed-cylinder-operating carriage to move the latter in a backward direction for the feed-pin 113 to rotate the cam-slotted feed-controller a quarter-turn, thus rotating the feed-cylinder a corresponding distance to discharge the empty shell and bring a fresh ammunition charge into line with the gun. The master-gear is now reversed by reason of the gears 181 182 becoming free and the gears 172 173 meshing with each other, and the feed-cylinder-operating carriage is thus moved in a forward direction, without, however, affecting the feed-cylinder, because the feed-pin rides in a straight groove, and at the same time the loading-carriage is advanced to repeat the loading operation, set the firing-bolt by engagement with the sear, and lower the breech-block. The operations of loading, firing, and extracting the shell are continued automatically and the feeder is rotated by the inclined rod in the loading-carriage in the intervals between the step-by-step feed of the feed-cylinder, so that a fresh charge is deposited in the feed-cylinder while the previous charge was being loaded into the gun, fired, and its shell is extracted.

To load the gun by power from the power-shaft and control the firing mechanism by hand, the operator shifts the lever 196 to the second or middle notch 200 of the segment (see Figs. 11 and 12) and the pawl 202 engages with the shipping-rod, while the lip 207 of the lever 196 lowers the short arm of the setting-lever 208 for the shoulder 190 on said rod 188 to lie in the path of the cam-lug 179 on the gear 173 of the first train of mutilated gears. With the carriage 72 in the position shown by Fig. 6 the gear-train 172 173 rotates in the direction indicated by the arrows in Fig. 11 and the master-gear is driven in a direction to advance the carriage 72 to loading position and to move the ring for adjusting the breech-block; but at this period the cam-lug 179 of the gear 173 impinges against the shoulder 190 to move the rod 188 rearwardly and disengage the clutch member 166 from the member 165, thus disengaging the counter-shaft from the power-shaft and permitting the driving mechanism to stop. The breech-block having been lowered and the firing-bolt set during the advancement of the carriage the attendant fires the charge by pulling the lanyard to make the cam-plate 126 actuate the rock-shaft to release the sear from the firing-bolt, and the latter is impelled against the firing-pin to explode the charge. The attendant now moves the setting-lever 208 to lift the shipping-rod and permit the spring 195 to move the shipping-rod forward and move the clutch member 166 into engagement with the clutch member 165, thus rotating the counter-shaft from the power-shaft. The train of gears 181 182 rotate the master-gear to lift the breech-block, retract the loading-carriage to extract the shell, and deposit the latter in the feed-cylinder, and the master-gear moves the feed-carriage backward to rotate the feed-cylinder to discharge the empty shell and bring the fresh charge into line with the breech. The gears 181 182 are now disengaged, and the gears 172 173 move into mesh to reverse the direction of the master-gear, the loading-carriage again advanced to force the charge into the breech, set the firing-bolt, and lower the breech-block, and at this period the cam-lug 179 rides against the shoulder 190 to retract the rod 188 and move the clutch member 166 out of engagement with clutch member 165, thus again loading the

gun and placing it in condition to be fired by hand. By moving the lever 196 to the third or last notch 201 of the segment the lip 207 of the lever 196 moves the setting-lever to an elevated position to raise the shipping-rod 188 for its shoulder 190 to be above or out of the path of the cam-lug 179, and said lever 196 also moves the rod 188 rearwardly to withdraw the clutch member 166 away from the member 165, thus throwing the entire mechanism out of gear.

Changes in the form, proportion, size, and the minor details of construction within the scope of the appended claims may be resorted to without departing from the spirit or sacrificing any of the advantages of this invention.

In the drawings, Figs. 3 to 8, inclusive, the seat 48 for the cam-block adjuster is shown as formed by a band or sleeve 48ª, which may be shrunk on or otherwise fixed to the gun-breech, and to this seat-forming band is affixed the plate 98, which forms the support for the front end of the feed-cylinder shaft, said plate being fixed to the band 48ª by screws or other devices, whereby the plate serves to form one wall or ledge of the seat to prevent the cam-block adjuster from endwise displacement on the gun-breech.

In the firing mechanism I have also provided a safety-stop for the sear 126, which limits or arrests the accidental upward movement of the sear when the gun is being sighted and until the lanyard-rod shall be actuated by hand to release the firing-bolt. This safety-stop 126ª is fixed to a bridge-piece of the frame 116 above the horizontally-movable slide 123, and said safety-lock is provided with a beveled face 126ᵇ and is positioned to lie in the path of a beveled face of the sear (see Figs. 23 and 24) under one adjustment of the slide. When the firing mechanism is to be released by hand under a pull on the lanyard, the slide 123 is drawn to the position shown by Fig. 24 to bring the sear 126 contiguous to the safety-stop 126ª, and thereby adapt the stop to overhang the sear in a manner to prevent upward movement of the sear accidentally, as when the gun is sighted; but when the lanyard-rod is actuated the slide 123 is moved endwise to carry the sear 126 away from the safety-stop and cause the inclined edge 128 of said sear to ride on the cam 57 of the breech-block adjuster, and thereby retract the detent from the firing-bolt.

The locking-piece 115 on the feed-cylinder-operating carriage has the advantage of being a safety-lock for the magazine when the projectile is being loaded and discharged to prevent the magazine from movement when the gun is worked at high speed, and said safety-lock takes the sudden strain off the feed finger or spindle 113 when a charge of great weight is deposited in the magazine.

By reference to Figs. 2 and 3 of the drawings it will be noted that the crank-shaft 157 is arranged in alinement with and in the plane of the trunnions 32, which support the gun, and the bracket 155 is attached to the platform or base that serves to pivotally support the gun. The arrangement of the crank-shaft 157 in alinement with the gun-trunnions is advantageous, because the gun may be raised or depressed without interfering with the rotation of the shaft 157 or throwing the driving-gear out of service, and by having the crank-shaft mounted on the bed said shaft is adapted to be shifted or turned with the gun under variation of the arc of fire of the ordnance.

The breech of the gun is provided in the lower side thereof with a vertical cleaning-aperture 216. Said aperture lies at right angles to the axis of the gun-bore, and it is produced in the breech at a point in rear of the seat or ledge for the rim of the charge, as shown by Figs. 4 to 8, inclusive. Said aperture assists in keeping the gun free from accumulations or deposits of sediment.

What I claim is—

1. In a gun, the combination of a single reversible master-gear, a feed-cylinder, a loading-carriage actuated by said master-gear and disposed in active relation to the feed-cylinder to transmit a charge therefrom into the gun-breech, a breech-block separate from the loading-carriage, a feed-cylinder-operating carriage actuated by the master-gear alternately with the loading-carriage, mechanism connecting the feed-cylinder-operating carriage with the feed-cylinder for rotating the latter in the intervals between the travel of the loading-carriage and with a step-by-step feed, substantially as described, for the purposes specified.

2. In a gun, the combination of a single reversible master-gear, two carriages in active relation to said master-gear and operable thereby independently of each other, a feed-cylinder in active relation to one carriage for interposing a charge in the path thereof, means connecting the other carriage and the feed-cylinder to rotate the latter with a step-by-step feed and in the intervals between the travel of the aforesaid carriage, a breech-block separate from either of the carriages, and means connecting the master-gear with said breech-block to adjust the latter during a period of rest of one carriage, substantially as described.

3. In a gun, the combination with a loading mechanism, and a feeding mechanism, of a reversible master-gear for actuating the loading and feeding mechanisms separately and alternately, a power-shaft, a reversible driving mechanism in active relation to the master-gear for automatically changing the direction and rotation thereof to advance and retract the loading and feeding mechanisms, and a reciprocatory breech-block separate from the loading or feeding mechanisms and actuated by the reversible master-gear, substantially as described.

4. In a gun, the combination with a breech, and a feed-cylinder, of a master-gear having

three several series of teeth, a loading-carriage actuated by the gear, a feed-cylinder-operating carriage also actuated by the gear, a breech-block, and a block-adjusting mechanism controlled by said gear and connected with said breech-block, substantially as described.

5. In a gun, the combination with a loading mechanism, a cartridge-feeding mechanism, and a breech-block mechanism separate from the loading and feeding mechanisms, of a master-gear having operative connection with each of said mechanisms, a firing mechanism operable by said breech-block mechanism, and a reversible and clutch-driving mechanism in active relation to said master-gear and including devices whereby the master-gear may be rotated back and forth continuously, or permitted to remain at rest periodically after the loading shall have been effected, or thrown out of service by the adjustment of a single lever, substantially as described.

6. In a gun, the combination with a loading mechanism, and a reciprocatory breech-block, of a reversible master-gear for actuating said loading mechanism, a breech-block adjuster having operative connection with said master-gear and the breech-block, and mechanism for automatically rotating the master-gear back and forth to open and close the breech-block and to advance and retract the loading mechanism, substantially as described.

7. In a gun, the combination, of a reversible master-gear, a loading mechanism, a breech-block, an adjusting device driven by the master-gear and controlling the breech-block, a firing mechanism and coacting cam devices between the breech-block-adjusting mechanism and the firing mechanism to release the latter, substantially as described.

8. In a gun, the combination with a breech having a feed-cylinder, and a loading mechanism, of a master-gear arranged to intermittently actuate the loading mechanism and said feed-cylinder through intermediate connections, a breech-block movable relatively to said breech, an adjuster connected directly with the master-gear and said breech-block for positively actuating the latter to open and close the breech, and a firing mechanism having one element thereof disposed in the path of the breech-block adjuster, whereby the firing mechanism may be released automatically by movement of the breech-block adjuster subsequent to the closing of the breech-block, substantially as described.

9. In a gun, the combination with a breech, a loading mechanism, and a feed-cylinder, of a master-gear to intermittently actuate through suitable connections said loading mechanism and the feed-cylinder, a reciprocating breech-block movable across the breech, a firing mechanism having an element disposed contiguous to the breech-block, and a breech-block adjuster driven from the master-gear and having means for reciprocating the breech-block and releasing the element of the firing mechanism automatically, substantially as described.

10. In a gun, the combination with a breech, of a reciprocating breech-block movable across the breech, an adjuster fitted to the breech for rotation thereon and connected directly with the breech-block, and a master-gear engaging with the adjuster to turn the latter on the breech, substantially as described.

11. In a gun, the combination with a breech, of an adjuster seated thereon against displacement and capable of turning freely, a breech-block having cam-slotted connections with said adjuster to be reciprocated positively thereby, a master-gear meshing directly with the adjuster to rock the latter in its seat on the breech, a loading mechanism, a feed-cylinder, and a firing mechanism having one element thereof carried by the loading mechanism, and another element disposed in the path of the breech-block adjuster, substantially as described.

12. In a gun, the combination with a breech, of an adjusting ring or sleeve fitted to said breech and provided with a curved eccentric arm, a reciprocating breech-block fitted to the breech and connected directly with the eccentric arm and said adjuster, and means for oscillating the adjuster on the breech to positively reciprocate the breech-block, substantially as described.

13. In a gun, the combination with a breech, of a reciprocating block actuated to travel in a rectilinear path across the breech, an oscillating adjuster connected directly with the breech-block to reciprocate the latter, a master-gear meshing with the adjuster to rock or turn the latter on the breech, a firing mechanism having an element disposed in the path of said adjuster, a loading mechanism actuated from the master-gear and carrying a firing-bolt forming a part of said firing mechanism, and a feed-cylinder arranged to interpose a charge in the path of the loading mechanism to be advanced by the latter into the breech previous to closing the breech-block, substantially as described.

14. In a gun, the combination with a feed-cylinder, of a feed-cylinder-operating carriage mounted to travel in a path parallel to the axis of said feed-cylinder, a feed-controller fast with the feed-cylinder shaft and having spiral grooves intersected by longitudinal straight grooves, a yieldable spindle mounted in said carriage to ride in the grooves of the feed-controller, a loading-carriage, and mechanism for actuating the feed-cylinder-operating carriage alternately with the loading-carriage, substantially as described.

15. In a gun, a feed-controller comprising a cylinder having the longitudinal grooves and the spiral grooves arranged to intersect with the longitudinal grooves, and a finger or spindle which traverses said grooves to rotate, with a step-by-step feed, said feed-controller during the periods of travel of said

spindle in the spiral grooves, in combination with a feed-cylinder, a loading-carriage, and means for making the finger or spindle pursue a rectilinear path parallel to the axis of the feed-controller, substantially as described.

16. In a gun, the combination with a breech, a movable breech-block, and a loading mechanism, of a chambered revoluble feed-cylinder having its axis in eccentric relation to the axis of the breech for presenting its chambers successively in alinement therewith, a feed-controller fast with the feed-cylinder and provided with straight and spiral grooves or slots, a reciprocating feed-cylinder-operating carriage having a spring-actuated finger which is movable in a rectilinear path and is engaged operatively with the feed-controller, and means for actuating the feed-cylinder-operating carriage in the intervals between the travel of the loading mechanism, substantially as described.

17. In a gun, the combination with a breech, a movable breech-block, and a loading mechanism, of a revoluble chambered feed-cylinder contiguous to the breech, a feed-controller revoluble with said feed-cylinder and having the straight grooves connected by spiral grooves forming the ledges or shoulders, a reciprocating feed-carriage contiguous to the feed-controller, a spring-controlled feed-finger mounted on said carriage and engaging with the curved feed-controller for rotating the latter and the feed-cylinder with a step-by-step feed, and means for positively reciprocating the feed-carriage in the intervals between the travel of the loading mechanism, substantially as described.

18. In a gun, a means for rotating a feed-cylinder with a step-by-step feed consisting of a cam-slotted feed-controller provided with a series of longitudinal parallel grooves, and a like series of spiral grooves each connecting the longitudinal grooves in pairs and tapered from one groove to the other to form the intermediate shoulders at the point where said spiral grooves open into the longitudinal grooves, substantially as described.

19. In a gun, the combination with a breech, a reciprocating breech-block, and a loading mechanism, of a revoluble chambered feed-cylinder provided in each of its chambers with a longitudinal groove, an extractor carried by the loading mechanism and disposed to travel successively in the grooves of the feed-cylinder chambers, and means for intermittently rotating the feed-cylinder in the interval between the reciprocating play of the loading mechanism and the extractor thereon, substantially as described.

20. In a gun, the combination with a breech, and a movable breech-block, of a reciprocating loading-carriage, a revoluble chambered feed-cylinder provided in each of its chambers with a longitudinal groove, a pusher supported on said loading-carriage and arranged to travel in the groove of the feed-cylinder chamber on the forward movement of the loading-carriage to introduce the charge from said feed-cylinder into the breech, means for positively reciprocating the loading-carriage during the periods of rest of the feed-cylinder, and an intermittent feed mechanism connected operatively with said feed-cylinder to rotate the latter during the rearward movement of the loading-carriage, substantially as described.

21. In a gun, the combination with a breech and a movable breech-block, of a reciprocatory loading-carriage, an extractor mounted on said carriage to travel therewith, a master-gear, and coacting cam and gear devices between the master-gear and said loading-carriage, said devices arranged to successively actuate said carriage, substantially as described.

22. In a gun, the combination with a breech, and a movable breech-block, of a reciprocating loading-carriage having means for introducing the charge into the breech, and a master-gear meshing with a rack on said carriage and provided with a cam arranged to retract the carriage by a wedging action, whereby an extractor supported by the carriage may withdraw the expanded shell from the breech previous to the teeth of the master-gear meshing with a rack on said carriage, substantially as described.

23. In a gun, the combination with a breech, and a movable breech-block, of a reciprocating loading-carriage having a rack and a notched bed, an extractor supported on said bed, and a master-gear meshing with the rack and having an eccentric rib arranged to impinge against the notched bed for retracting the carriage previous to engagement of the gear-teeth with said rack, substantially as described.

24. In a gun, the combination with a breech, and a movable breech-block, of a reciprocating carriage provided with a rack, a post having a bed and fixed to the carriage to travel therewith, a firing-bolt mounted on said bed to move independently of the travel of the carriage, an extractor also carried by the bed to engage with the shell in the breech, and a master-gear meshing with the rack of the carriage and having a cam-rib to ride against the bed and engage a notch thereon, substantially as described.

25. In a gun, a loading-carriage, a master-gear, coacting cam devices between the master-gear and the carriage to actuate the latter for one period of its travel, and gear-teeth between said carriage and master-gear to propel the carriage on the disengagement of the cam devices, in combination with an ammunition-feed mechanism, a breech-block, and a firing mechanism, substantially as described.

26. In a gun, the combination with a breech, and a loading mechanism, of a chambered feed-cylinder mounted in eccentric relation to the breech, an oscillating feeder hung on a horizontal axis above the feed-cylinder for depositing ammunition charges in the chamber of said feed-cylinder, and means actu-

ated by the loading mechanism for rocking said feeder during the periods of rest of the feed-cylinder, substantially as described.

27. In a gun, the combination with a breech, and a loading mechanism, of a chambered feed-cylinder mounted for rotation in eccentric relation to said breech, an oscillating feeder hung on a horizontal axis above the feed-cylinder and arranged to deposit ammunition charges in the feed-cylinder chambers, a feed-chute above said feeder, and means operatively connected to the feeder and actuated by the loading mechanism to rock the feeder during the periods of rest of the feed-cylinder, substantially as described.

28. In a gun, the combination with a breech, of a loading-carriage, a chambered feed-cylinder mounted in eccentric relation to the breech, an intermittent feed mechanism connected with the feed-cylinder and operated independently of the loading-carriage, an oscillating feeder hung on a horizontal axis above the feed-cylinder, and actuating devices connected with the feeder and with the loading-carriage, substantially as described.

29. In a gun, the combination with a breech, and a loading-carriage, of a chambered feed-cylinder mounted in eccentric relation to the breech for rotation on a horizontal axis, an oscillating feeder hung above and to one side of the vertical plane of the magazine-axis, an intermittent feed mechanism for said feed-cylinder, a cam-track movable with the loading-carriage, and connections between said cam-track and the oscillating feeder, substantially as described.

30. In a gun, the combination with a breech, and a loading-carriage, of an inclined cam-rod supported on the carriage to travel in a rectilinear path therewith, a chambered feed-cylinder in eccentric relation to the breech, an oscillating feeder hung on a horizontal axis above said feed-cylinder and provided with a crank-arm, and an operative connection between the arm of said feeder and the inclined track-rod on said loading-carriage, substantially as described.

31. In a gun, the combination with a breech, and a loading-carriage, of a chambered feed-cylinder in eccentric relation to said breech, a feed-chute above the feed-cylinder, a feeder below the feed-chute and mounted on a horizontal axis above the feed-cylinder for vibration in a vertical plane to present a receptacle to the chute and to the chambers of said feed-cylinder as the latter is rotated with a step-by-step motion, means actuated by the loading-carriage to rock the feeder during the periods of rest of the feed-cylinder, and an intermittent feed mechanism operating independently of the loading-carriage and the feeder to turn the feed-cylinder on its axis, for the purpose described, substantially as described.

32. In a gun, the combination with a loading-carriage having mounted thereon a firing-bolt adapted to be set on the movement of the carriage to its loading position, a breech-block, and a breech-block-adjusting mechanism, of a firing mechanism including a sear, and coacting cam devices between the breech-block-adjusting mechanism and the firing mechanism to actuate the latter and retract the sear from the path of the firing-bolt, substantially as described.

33. In a gun, the combination with a breech, of a breech-block carrying a firing-pin, a breech-block-adjusting mechanism arranged to open and close the breech-block, a loading-carriage equipped with a firing-bolt, a firing mechanism having a sear in the path of the firing-bolt to automatically set the latter on the advancement of the loading-carriage, and coacting cam devices between the breech-block adjuster and the firing mechanism to automatically release the firing-bolt, substantially as described.

34. In a gun, the combination with a breech, and a breech-block carrying a firing-pin, of a breech-block-adjusting mechanism provided with a cam, a loading-carriage having a firing-bolt, a sear disposed in the path of said firing-bolt to automatically set the latter on the advancement of the carriage, a cam-plate connected operatively with the sear and arranged to ride upon the cam of the breech-block-adjusting mechanism, and means for moving said cam-plate with relation to the cam, substantially as described.

35. In a gun, the combination of a breech-block, a breech-block-adjusting mechanism, a loading-carriage supporting a carrying-plate, a firing mechanism including a sear, and coacting cam devices between the breech-block-adjusting mechanism and the firing mechanism, one element of said cam device being operable automatically by the breech-block-adjusting mechanism, and another element of the cam device adapted to be adjusted manually, the automatic or manual movement of said devices serving to release the firing-bolt, substantially as described.

36. In a gun, the combination with a breech, of a movable breech-block carrying a firing-pin, a loading-carriage equipped with a firing-bolt disposed in the plane of said firing-pin, a rock-shaft disposed out of the path of the loading-carriage, a sear connected operatively with the rock-shaft and adapted to be deflected thereby from the path of the firing-bolt, a cam-slotted plate with which said rock-shaft is connected for operation thereby, and means substantially as described for moving the cam-slotted plate to retract the sear from the path of the firing-bolt, substantially as set forth.

37. In a gun, the combination with a breech, of a movable breech-block carrying a firing-pin, a loading-carriage equipped with a firing-bolt disposed in the plane of said pin, a sear normally interposed in the path of the firing-bolt, a cam-plate actively connected through intermediate connections with said sear, and a breech-block adjuster operatively connected

with the breech-block and provided with means for moving the cam-plate to retract the sear from the path of the firing-bolt, substantially as described.

38. In a gun, the combination with a breech, of a movable breech-block carrying a firing-pin, a loading-carriage equipped with a firing-bolt disposed in the plane of the firing-pin, a breech-block adjuster connected operatively with the breech-block and provided with means for releasing a firing mechanism, and a firing mechanism having one element thereof disposed in the path of the releasing device on the breech-block adjuster and another element in the path of the firing-bolt on the loading-carriage, whereby the breech-block adjuster may actuate the firing mechanism to retract the sear from engagement with the firing-bolt subsequent to the closure of the breech-block by said adjuster, substantially as described.

39. In a gun, the combination with a breech, of a movable breech-block carrying a firing-pin, a loading-carriage equipped with the firing-bolt, a breech-block adjuster operatively connected with the breech-block and provided with a cam-lug, and a firing mechanism including the connected sear and cam-plate, said cam-plate being arranged to ride upon the cam-lug of the breech-block adjuster, and said sear being disposed in the path of the firing-bolt, the whole arranged and combined for service, substantially as described, and for the purpose set forth.

40. In a gun, the combination with a breech, of a movable breech-block carrying a firing-pin, a loading-carriage equipped with a firing-bolt disposed in the plane of said firing-pin, a breech-block adjuster connected operatively with the breech-block and having a cam-lug, a rock-shaft lying out of the path of the firing-bolt, a sear connected with said rock-shaft to be retracted thereby from the firing-bolt, and a cam-plate connected with the rock-shaft and disposed in the path of the cam-lug of the breech-block adjuster, substantially as described.

41. In a gun, the combination with a breech, of a movable breech-block carrying a firing-pin, a loading-carriage equipped with a firing-bolt, a sear disposed in the path of the firing-bolt, a cam-plate with intermediate connections to said sear, a cam-lug in the path of the cam-plate for moving the latter to retract the sear from the path of the firing-bolt, and means for imparting rectilinear movement to the cam-plate to ride upon the cam-lug, substantially as described.

42. In a gun, the combination with a breech, of a movable breech-block carrying the firing-pin, a loading-carriage equipped with the firing-bolt, a sear in the path of said firing-bolt, a carrier-plate mounted for rectilinear movement with relation to the breech-block, a cam-plate supported by the carrier-plate and connected through intermediate devices with said sear, means in the path of the cam-plate to actuate the latter on the movement of the carrier-plate to retract the sear from the path of the firing-bolt, and manually-operated devices for moving the carrier-plate, substantially as described.

43. In a gun, the combination with a breech, of a movable breech-block, a breech-block adjuster for opening and closing the breech-block, a firing-bolt, a sear, a yieldable cam-plate connected with said sear, a cam on the breech-block adjuster and disposed in the path of the cam-plate, and means for moving the cam-plate, whereby the sear may be retracted from the path of the firing-bolt either automatically or manually, substantially as described.

44. In a gun, the combination with a breech, of a movable breech-block carrying a firing-pin, a loading-carriage equipped with a firing-bolt, a sear, a cam-plate connected through intermediate devices with said sear, a carrier-plate on which the cam-plate is mounted, a lanyard-rod connected with the carrier-plate for imparting reciprocating play thereto, and means in the path of the cam-plate for lifting the latter to retract the sear from the firing-bolt, substantially as described.

45. In a gun, the combination with a breech, of a grooved breech-block carrying a firing-bolt, guides engaging with said grooved block to direct the latter to rectilinear movement in a path across the breech, an oscillating adjuster mounted on the breech and having cam-slotted connections with the breech-block, a loading mechanism equipped with a firing-bolt disposed in alinement of the firing-pin with said breech-block, and a firing mechanism to engage with the firing-bolt on the advancement of the carriage and adapted to release said firing-bolt, for the purpose described, substantially as described.

46. In a gun, the combination with a breech, of a movable breech-block carrying a firing-pin, a loading-carriage equipped with a firing-bolt, a sear in the path of said firing-bolt, a reciprocating carrier-plate, a cam-plate hung to said carrier-plate to travel therewith and capable of independent movement thereon, operative connections between the cam-plate and the sear, means for moving the cam-plate independently of the play of the carrier-plate, and manually-operated devices connected with said carrier-plate for moving the latter relatively to the breech-block, substantially as described.

47. In a gun, the combination with a breech, of a movable breech-block carrying a firing-pin, a firing-bolt, a sear disposed in the path of the firing-bolt, a rock-shaft connected with the sear, a carrier-plate mounted for movement across the plane of the rock-shaft, a cam-plate hung on the carrier-plate to travel therewith and connected with the rock-shaft, means in the path of the cam-plate to move the latter and the rock-shaft on the recipro-

cation of the carrier-plate, and manually-operated devices for reciprocating the carrier-plate, substantially as described.

48. In a gun, the combination with a breech, of a movable breech-block carrying a firing-pin, a firing-bolt lying in the line of the firing-pin, a carrier-plate supporting a cam-plate, a rock-shaft linked to the cam-plate and to a sear which lies in the path of the firing-bolt, and a lanyard-rod having cam-slotted connections with the carrier-plate, substantially as described.

49. In a gun, the combination with a breech, of a movable breech-block carrying a firing-pin, a firing-bolt disposed in alinement with the firing-pin, a sear in the path of said firing-bolt, a reciprocating plate having means operatively connected with the sear to retract the latter from the path of the firing-bolt subsequent to the closure of the breech-block, and a lanyard-rod having cam-slotted connections with the carrier-plate, substantially as described.

50. In a gun, the combination with a breech, of a movable breech-block carrying a firing-pin, a firing-bolt disposed in line with said firing-pin on the closure of the breech, a breech-block adjuster connected operatively with said breech-block and provided with a cam-lug, a firing mechanism including a cam-plate and a sear connected operatively together, said cam-plate alined in the path of the cam-lug on the breech-block adjuster, and the sear disposed in the path of the firing-bolt, means for manually moving the cam-plate with relation to the cam-lug on the breech-block adjuster, and a locking device to restrain the manually-operated means from influencing the position of the cam-plate and to advance said cam-plate into the path of the cam-lug on the breech-block adjuster for operation automatically thereby subsequent to the closure of the breech-block by said adjuster, substantially as described.

51. In a gun, the combination with a breech, of a breech-block carrying a firing-pin, a breech-block adjuster connected with said breech-block and provided with a cam-lug, a rock-shaft, a firing-bolt out of the path of the said rock-shaft and in alinement with the firing-pin on the closure of the breech, a sear disposed in the path of the firing-bolt and connected with the rock-shaft, a carrier-plate mounted for movement relatively to the cam-lug on the breech-block adjuster, a cam-plate on the carrier-plate and connected with the rock-shaft, and a lanyard-rod connected operatively with the carrier-plate, substantially as described.

52. In a gun, the combination with a breech, of a breech-block carrying a firing-pin, a firing-bolt in alinement with said firing-pin on the closure of the breech-block, a rock-shaft, a sear lying in the path of the firing-bolt and connected with said rock-shaft, a breech-block adjuster having a cam-lug, a carrier-plate mounted for rectilinear reciprocating play across the rock-shaft, a cam-plate hung on the carrier-plate and disposed in the path of the cam-lug of the breech-block adjuster, a lanyard-rod connected with the carrier-plate to reciprocate the latter, and a locking device associated with the lanyard-rod to lock said rod and the carrier-plate against movement and to interpose the cam-plate in the path of the cam-lug on said breech-block for operation automatically thereby, substantially as described.

53. In a gun, the combination with a breech, of a movable breech-block carrying a firing-pin, a firing-bolt in line with said firing-pin on the closure of the breech-block, a sear in the path of the firing-bolt, a rock-shaft connected with the sear, a pivoted cam-plate having cam-slotted connections with the rock-shaft, and a breech-block adjuster provided with a cam-lug arranged to ride against the cam-plate to retract the sear automatically from the path of the firing-bolt, substantially as described.

54. In a gun, the combination with a breech, of a breech-block carrying a firing-pin, a firing-bolt arranged to act upon the firing-pin, a breech-block adjuster provided with a cam-lug, a carrier-plate mounted for movement with relation to said cam-lug of the breech-block adjuster, a cam-plate hung on the carrier-plate for movement therewith and arranged to ride upon said cam-lug, a sear connected operatively with said cam-plate, a lanyard-rod having cam-slotted connection with the carrier-plate for positively reciprocating the latter, and a spring to normally position the carrier-plate for the cam-plate thereof to be out of the path of the cam-lug on said breech-block adjuster, substantially as described.

55. In a gun, the combination with a breech, and a movable breech-block carrying a firing-pin, of a firing-bolt, a sear in the path of said firing-bolt, a rock-shaft linked to said sear, a carrier-plate mounted for movement across the plane of the rock-shaft, a breech-block adjuster provided with a cam-lug, a cam-plate hung on the carrier-plate and having cam-slotted and link connections with the rock-shaft, a lanyard-rod having cam-slotted connections with the carrier-plate to positively reciprocate the latter, a spring to normally position the carrier-plate for the cam-plate to lie out of the path of the cam-lug on said breech-block adjuster, and a locking-lever arranged to engage with a detent and to confine the lanyard-rod against movement and to position the carrier-plate for its cam-plate to lie in the path of the cam-lug of said breech-block adjuster, substantially as described.

56. In a gun, the combination with a master-gear arranged to control the loading and firing mechanisms, of a power-shaft, a reversing mechanism in operative relation to the master-gear shaft and embracing two trains of oppositely-movable mutilated gears ar-

ranged to alternately rotate the master-gear positively in opposite directions, and a clutch-controlled shaft for driving the two trains of gears, substantially as described.

57. In a gun, the combination with a master-gear for operating the loading and extracting mechanisms, and a power-shaft, of a reversing driving mechanism in active relation to the master-gear shaft and including two trains of mutilated gears, means for simultaneously driving adjacent members of the trains simultaneously in opposite directions, and clutch mechanism connected operatively with the gear-driving devices, substantially as described.

58. In a gun, the combination with a master-gear for operating the loading and extracting mechanisms, and a power-shaft, of a reversible driving mechanism between said power-shaft and the master-gear and including a counter-shaft driven by the power-shaft, and two trains of mutilated gears driven by the counter-shaft and arranged to rotate the master-gear alternately in opposite directions, substantially as described.

59. In a gun, the combination with a master-gear for operating the loading and extracting mechanisms, and a power-shaft, of a reversible driving mechanism between said master-gear and the power-shaft, and including a counter-shaft and two series of mutilated gears, certain members of both gear-trains being fast with the master-gear shaft and other members of said gear-trains being continuously driven in opposite directions by the counter-shaft and arranged to alternately actuate the driven gear members in opposite directions, substantially as described.

60. In a gun, the combination with a master-gear for operating the loading and extracting mechanisms, and a power-shaft, of a reversible driving mechanism including two trains of mutilated gears comprising members fast with the master-gear shaft and other members driven in opposite directions by said power-shaft, whereby the master-gear is rotated positively in opposite directions alternately, substantially as described.

61. In a gun, the combination with a master-gear for operating the loading and extracting mechanisms, and a power-shaft, of a reversible driving-gear including a counter-shaft, two trains of mutilated gears between said counter-shaft and the master-gear shaft, a clutch mechanism operatively arranged to the power-shaft and the counter-shaft, and means for controlling the clutch mechanism, substantially as described.

62. In a gun, the combination with a master-gear for operating the loading and extracting mechanisms, and a power-shaft, of a reversible driving-gear including a counter-shaft, two trains of mutilated gears between the counter-shaft and the master-gear shaft, a clutch mechanism, and means for automatically shifting the clutch mechanism at certain periods in the rotation of the master-gear, substantially as described.

63. In a gun, the combination with a master-gear for operating the loading and extracting mechanisms, and a power-shaft, of a reversible driving-gear including a counter-shaft, and two trains of mutilated gears between the counter-shaft and the master-gear shaft, a clutch mechanism between the power-shaft and the counter-shaft and a shipping-rod connected with said clutch mechanism and arranged in operative relation to one gear-train, substantially as described.

64. In a gun, the combination with a master-gear for operating the loading and extracting mechanisms, and a power-shaft, of a reversible driving mechanism including a counter-shaft, and two trains of mutilated gears, a clutch mechanism, a shipping-rod connected with said clutch mechanism and arranged to be operated by one of said gears to automatically disconnect the counter-shaft from the power-shaft at a certain period in the rotation of the master-gear, and means for throwing the shipping-rod out of active relation to the train of mutilated gears, substantially as described.

65. In a gun, the combination with a master-gear for operating the loading and extracting mechanisms, and a power-shaft, of a reversing driving-gear including a counter-shaft, and two trains of mutilated gears, a clutch mechanism, a shipping-rod connected with said clutch and disposed in operative relation to one of the gears for actuation automatically thereby, and manually-operative devices associated with the shipping-rod to release the latter from one gear-train and to control the clutch mechanism for its members to remain normally in or out of gear, substantially as described.

66. In a gun, the combination with a master-gear for operating the loading and extracting mechanism, and a power-shaft, of a reversible driving mechanisms embracing two trains of mutilated gears, a clutch mechanism, a shipping-rod connected therewith, an adjusting-lever connected to said shipping-rod to move the latter manually, and a setting-lever controlled by the adjusting-lever and arranged to release the shipping-rod from restraint by one of the gears, substantially as described.

67. In a gun, the combination with a master-gear for operating the loading and extracting mechanisms, and a power-shaft, of a reversing driving-gear including a counter-shaft, and two trains of gears actuated thereby, a clutch mechanism, a spring-controlled shipping-rod connected with the clutch and held in active relation to one gear-train, an adjusting-lever connected operatively with said rod, and a setting-lever to release the rod from the gear-train, substantially as described.

68. In a gun, the combination with a mas-

ter-gear for operating the loading and extracting mechanisms, and a power-shaft, of a reversible driving-gear, including a counter-shaft, and two trains of mutilated gears, a clutch, a shipping-rod connected with the clutch and disposed in active relation to one gear-train, a pressure-spring to impel the rod endwise and to hold the rod in the path of the gear-train, and means for controlling the rod manually, substantially as described.

69. In a gun, the combination with a master-gear for operating the loading and extracting mechanisms, and a power-shaft, of a reversible driving mechanism including a counter-shaft, and two trains of mutilated gears, a clutch, a shipping-rod having a notched rear end, a pressure-spring for said rod, a controlling-lever having pawl connections with said shipping-rod, and a setting-lever, substantially as described.

70. In a gun, the combination with a master-gear for operating the loading and extracting mechanisms, and a power-shaft, of a reversible driving mechanism including a counter-shaft, and two trains of mutilated gears, a clutch, a shouldered shipping-rod connected to the clutch and disposed in active relation to the gear-train, an adjusting-lever connected with said rod, means for locking said lever in either of three positions to control the shipping-rod, and means for releasing said shipping-rod under certain conditions, substantially as described.

71. In a gun, the combination with a master-gear for operating the loading and extracting mechanisms, and a power-shaft, of a reversible driving mechanism including a counter-shaft, and two trains of multilated gears, a clutch, a shipping-rod connected to the clutch, an adjusting-lever having a lip and connected to the rod, and a setting-lever disposed in active relation to the rod and controlled by the lip of said lever, substantially as described.

72. In a gun, the combination with a master-gear for operating the loading and extracting mechanisms, and a power-shaft, of a reversible driving mechanism including a counter-shaft, and two trains of mutilated gears actuated by the counter-shaft and one gear having a cam-lug, a clutch, a shouldered shipping-rod connected to said clutch and arranged for its shoulder to lie in the path of the cam-lug, a spring to control the rod, and means for changing the position of the rod, substantially as described.

73. In a gun, the combination with a master-gear for operating the loading and extracting mechanisms, and a power-shaft, of a reversible driving mechanism including a counter-shaft, and two trains of mutilated gears operated by said counter-shaft, a clutch, means for controlling the clutch, and an indicator device connected operatively with the clutch mechanism, substantially as described.

74. In a gun, the combination with a loading mechanism, of a chambered feed-cylinder, a feed-cylinder-operating carriage mounted to travel in a rectilinear path parallel to the axis of said feed-cylinder, a feed-controller between the carriage and feed-cylinder to rotate the latter, spaced locking-plates mounted on the carriage and engaging alternately with said feed-cylinder as the carriage completes its back-and-forth travel, a breech-block, and a firing mechanism, substantially as described.

75. In a gun, the combination of a breech having the longitudinal slots for the extractor and pusher, and a vertical guideway for the breech-block, a loading-carriage provided with the extractor and pusher to fit in said slots of the breech, a breech-block guided in the way of the breech, means for adjusting the breech-block, a feed-cylinder in the path of the extractor and pusher of the loading-carriage, and a feed-controller for said feed-cylinder, substantially as described.

76. The combination with a bed, and a gun having its breech pivoted thereon, of loading and firing mechanisms mounted on the gun-breech to be elevated or depressed therewith, a power-shaft mounted on the bed in alinement with the pivotal support of the gun, and a reversible driving mechanism actuated by said power-shaft and connected with the loading mechanism to normally maintain an operative relation thereto under all adjustments of the gun, substantially as described.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in the presence of two witnesses.

FREDERICK W. BROOKS.

Witnesses:
BENJAMIN VAN PRUNGH,
J. M. REED.