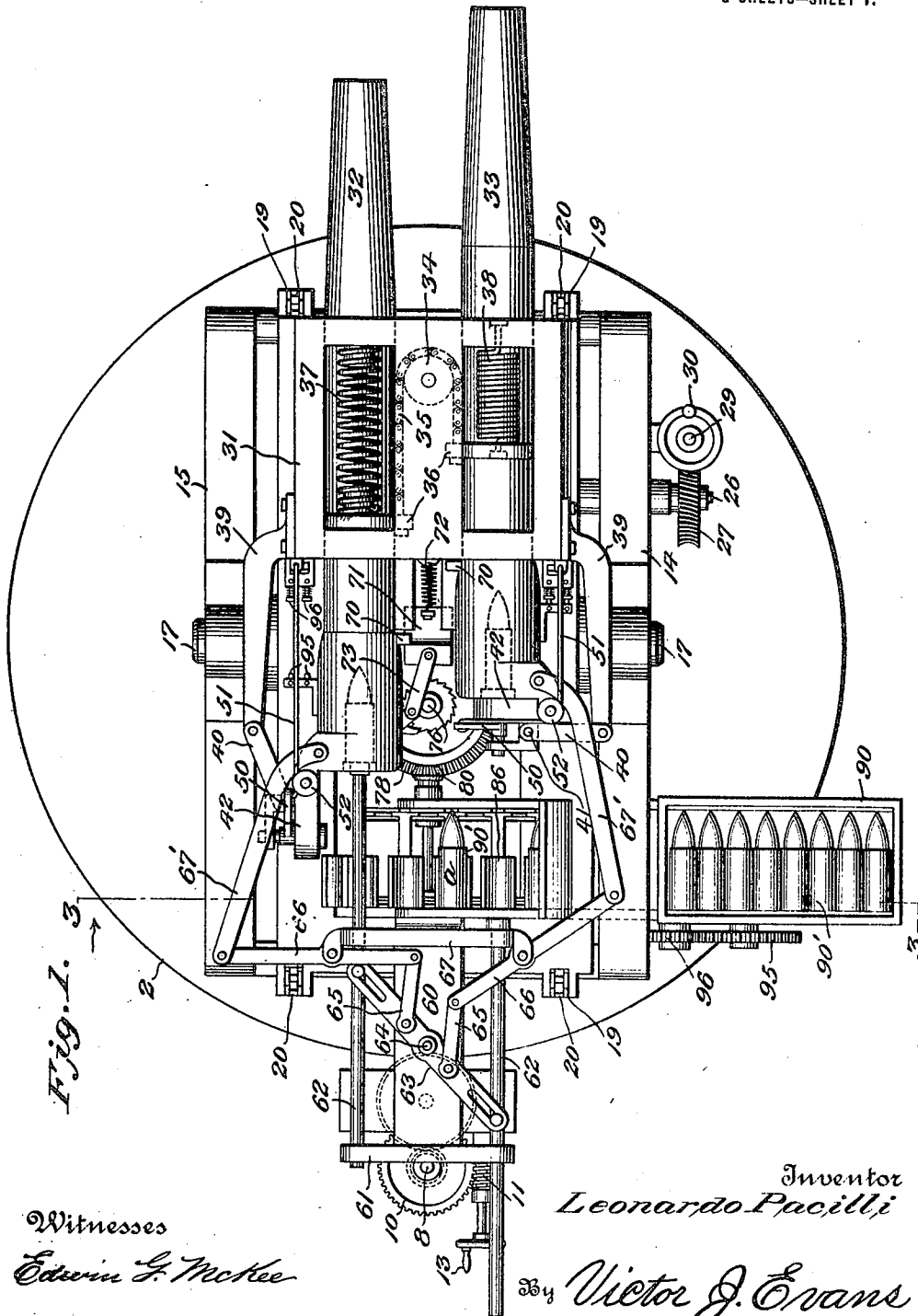


1,332,060.

L. PACILLI.
RECOIL OPERATED ORDNANCE.
APPLICATION FILED OCT. 15, 1918.

Patented Feb. 24, 1920.
5 SHEETS—SHEET 1.



Witnesses
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1,332,060.

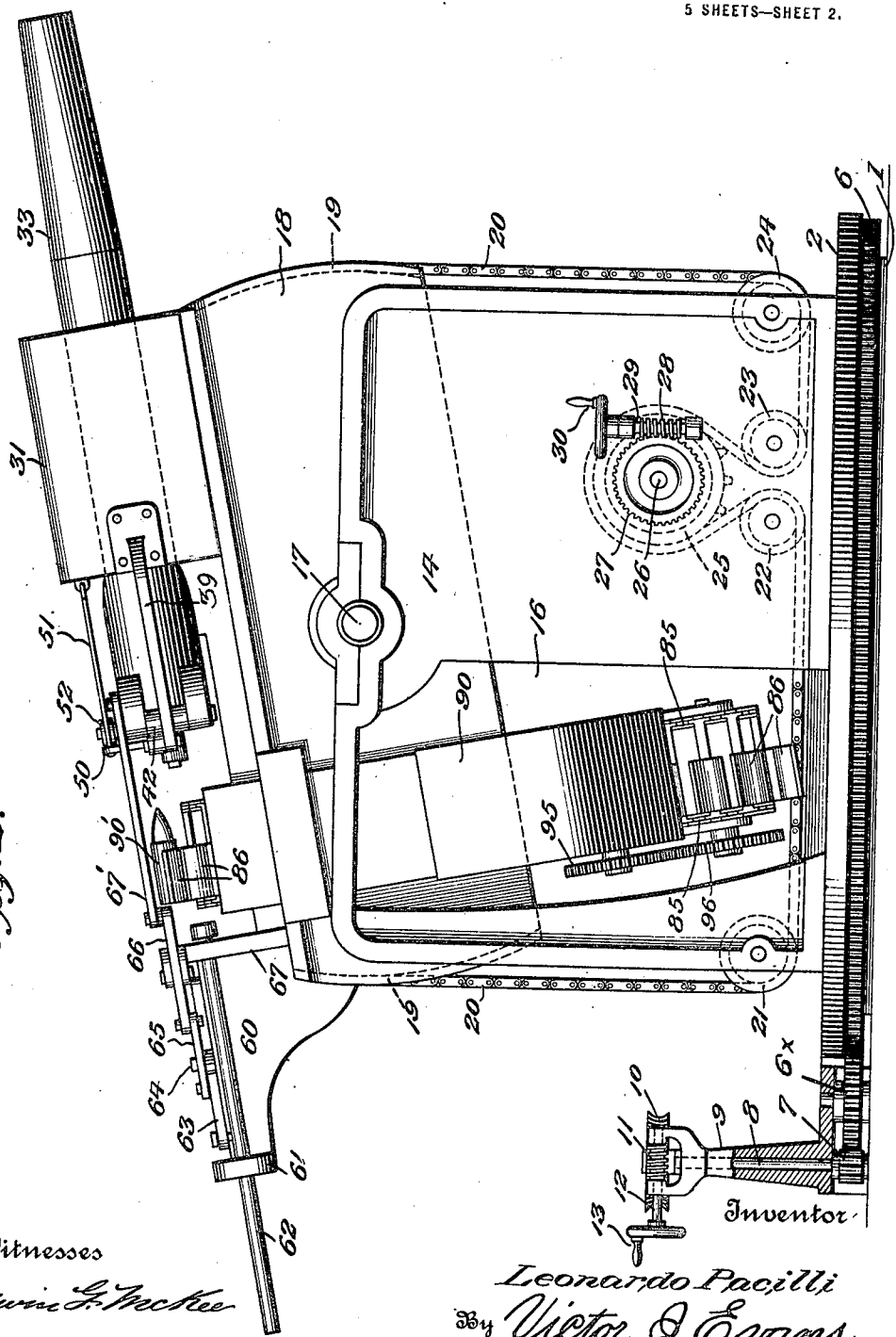
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5 SHEETS—SHEET 2.

Fig. 2.

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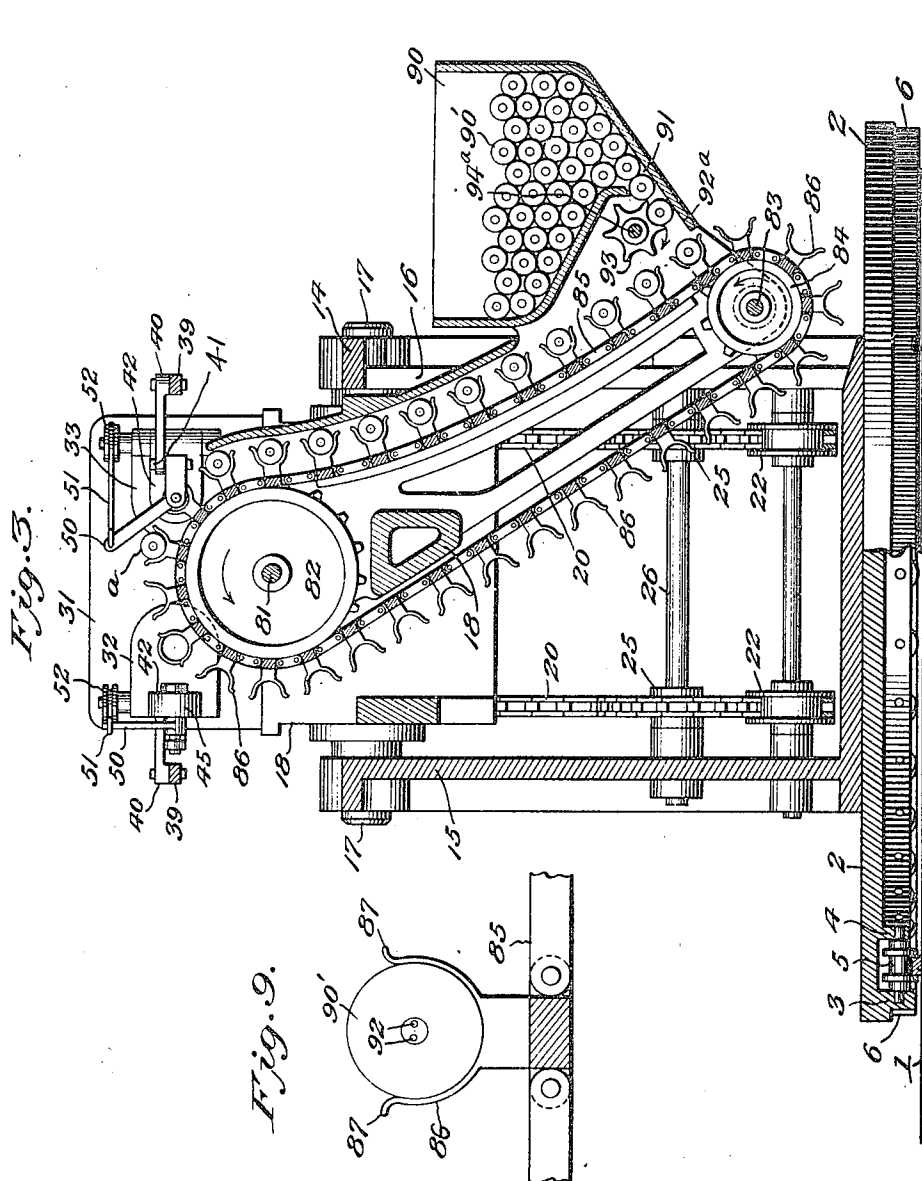


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5 SHEETS—SHEET 3.



Witnesses

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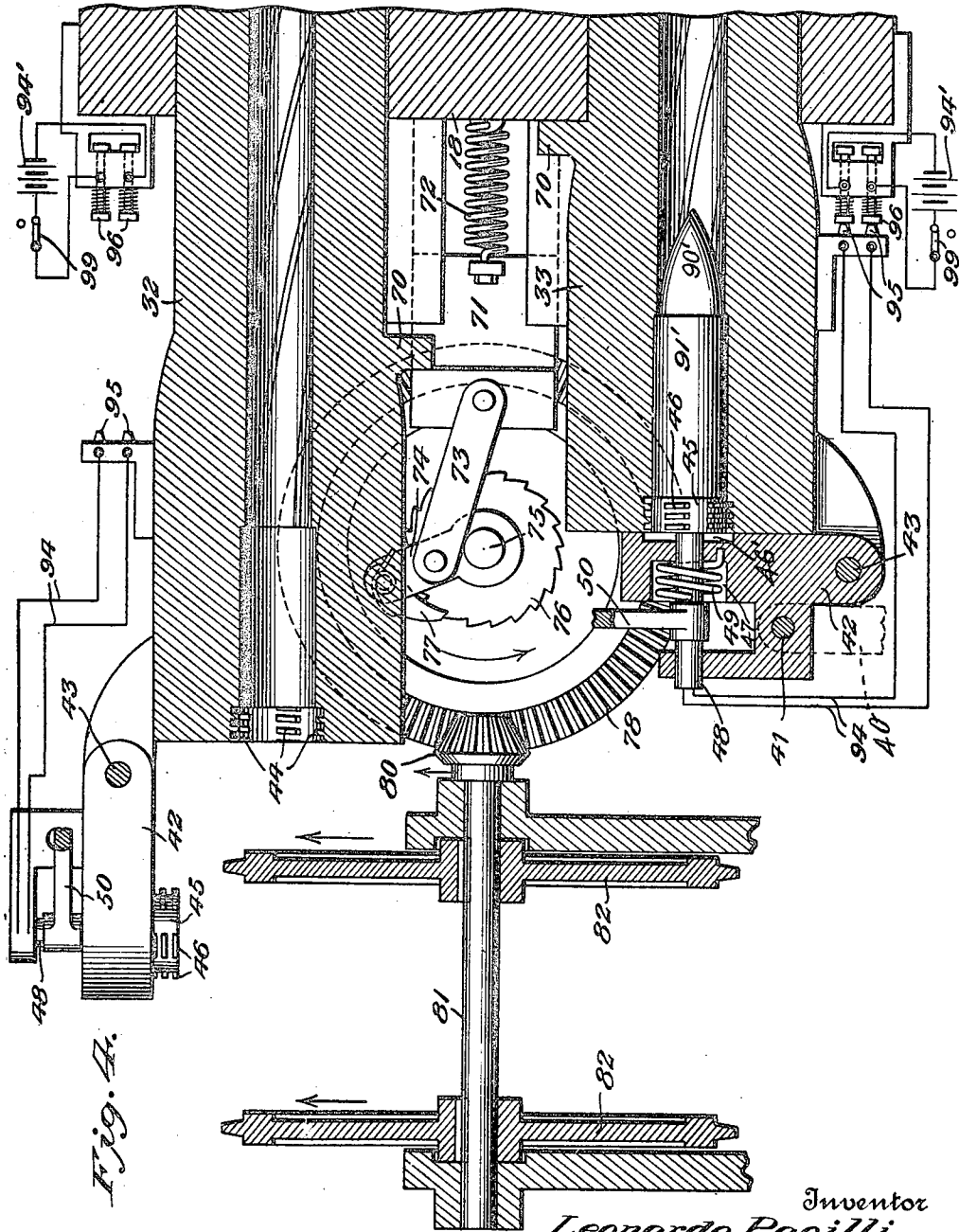
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5 SHEETS—SHEET 4.



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5 SHEETS—SHEET 5.

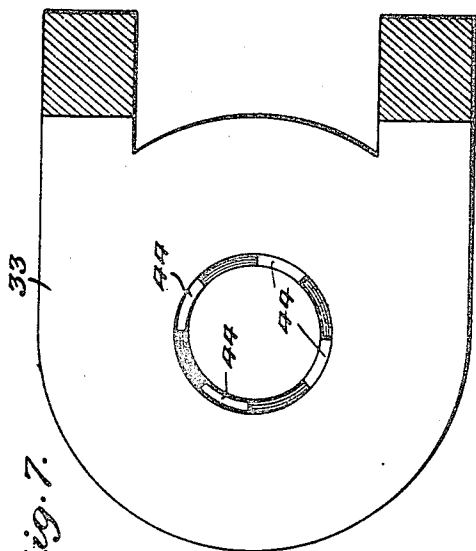


Fig. 7.

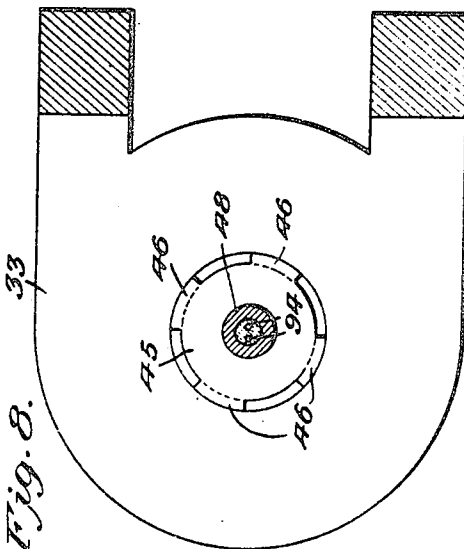


Fig. 8.

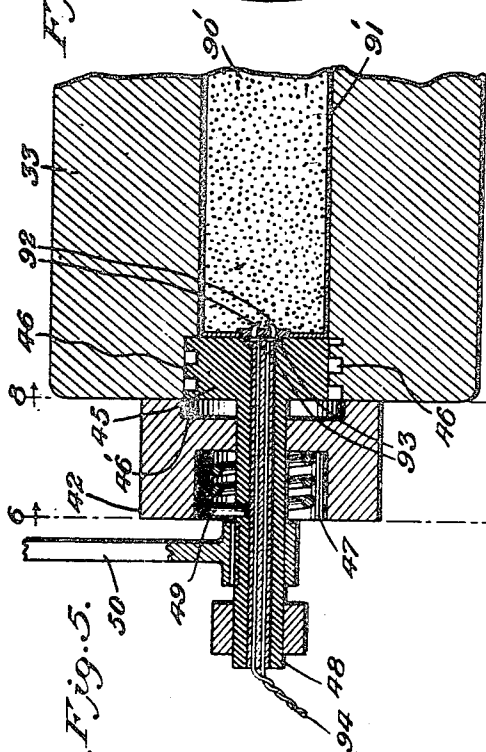


Fig. 5.

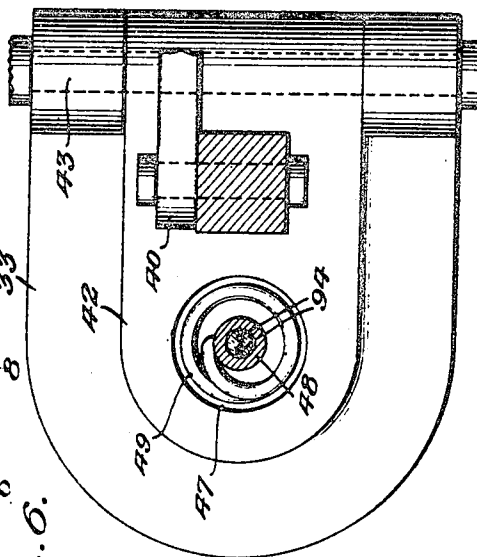


Fig. 6.

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UNITED STATES PATENT OFFICE.

LEONARDO PACILLI, OF COPPER CLIFF, ONTARIO, CANADA.

RECOIL-OPERATED ORDNANCE.

1,332,060.

Specification of Letters Patent.

Patented Feb. 24, 1920.

Application filed October 15, 1918. Serial No. 258,150.

To all whom it may concern:

Be it known that I, LEONARDO PACILLI, a subject of the King of Italy, residing at Copper Cliff, in the Province of Ontario and Dominion of Canada, have invented new and useful Improvements in Recoil-Operated Ordnance, of which the following is a specification.

My present invention pertains to recoil-operated ordnance, and is designed more particularly for embodiment in an organized mechanism embodying long range guns or cannons.

One of the objects of the invention is the provision in an organized mechanism of two guns arranged in parallelism in combination with strong and reliable means whereby the recoil of each gun will be utilized in the loading of the other gun, the closing of the breech thereof and the firing of said gun.

Another object of the invention is the provision in ordnance of the character defined of simple, strong and reliable means for utilizing the recoil of the guns to actuate in a step by step manner an ammunition conveyor complementary to both guns.

Another object is the provision of reliable and easily operated breech mechanism.

Another object is the provision of improved means for elevating and depressing the gun mechanism as a unit.

Another object is the provision of improved means for turning the gun mechanism as a unit about a vertical center in order to traverse the guns as occasion demands.

Other objects and practical advantages of the invention will be fully understood from the following description and claims when the same are read in connection with the drawings, hereby made a part hereof, in which:

Figure 1 is a plan view of my improved ordnance.

Fig. 2 is a side elevation of the same.

Fig. 3 is a transverse section taken in the plane indicated by the line 3—3 of Fig. 1, looking forwardly, and illustrating in detail the ammunition conveyor.

Fig. 4 is an enlarged detail horizontal section showing the mechanism for actuating the ammunition conveyor incidental to the recoil of each gun.

Fig. 5 is a detail diametrical section, showing the novel breech mechanism complementary to each gun.

Fig. 6 is a transverse section taken in the plane indicated by the line 6—6 of Fig. 5.

Fig. 7 is an elevation showing the breech of one gun *per se*.

Fig. 8 is a vertical section taken in the plane indicated by the line 8—8 of Fig. 5.

Fig. 9 is an enlarged detail of one of the shell cradles.

Similar numerals of reference designate corresponding parts in all of the views of the drawings.

Among other elements, my improved ordnance comprises a circular track 1, Fig. 3, and a revoluble table 2; the said table 2 being provided with depending and spaced circular flanges 3 and 4, in which are journaled the trunnions of flange rollers 5. The said rollers 5 straddle and bear on the track 1 with the result that the table may be turned about its axis in a horizontal plane with facility and yet the table is strongly held against rectilinear horizontal movement or displacement. On its perimeter the flange 3 is provided with spur gear teeth 6, and intermeshed with said teeth is an intermediate spur gear 6*, intermeshed, in turn, with a pinion 7 on an upright shaft 8, Figs. 1 and 2; the said shaft 8 being journaled in a fixed standard 9 and equipped near its upper end with a worm gear 10, with which is intermeshed a worm 11 on a horizontal shaft 12, having at its end a suitable crank 13. Manifestly by turning the crank 13 an attendant is enabled to rotate the table 2 about its axis with the expenditure of very little effort and with a view to traversing the guns as occasion requires.

Fixed to and rising from the table 2 are standards 14 and 15, the right hand standard 14 being provided with an opening 16 in its rear portion, Figs. 2 and 3.

Journaled in the standards 14 and 15 are trunnions 17 of the vertically swinging carriage 18 of my improvement. At its forward and rear ends and adjacent to its opposite sides, the said carriage 18 is provided with slightly convexed and grooved portions 19, designed to receive and hold against lateral displacement the long portions of sprocket cables 20; the said sprocket cables being connected at their ends to the carriage

portions 19 at points adjacent to the upper ends of said portions 19. Each of the cables 20 is carried around idlers 21, 22, 23 and 24 on each standard 14 and 15, and each sprocket cable is also carried around a sprocket gear 25. There are two of the sprocket gears 25, and they are fixed on a transverse shaft 26, which is journaled in the standards 14 and 15, and is equipped at the outer side of the standard 14 with a worm gear 27. The said worm gear is intermeshed with an upright worm 28 on a shaft 29 that bears a crank 30 at its upper end. By turning the said crank 30, an attendant is obviously enabled to quickly and easily elevate or depress the muzzles of the guns.

At 31 on the upper and forward portion of the carriage 18 is the guide housing for the guns 32 and 33, which guns are movable rectilinearly through the housing, and so that incidental to the recoil of one gun following the firing thereof, the other gun will be advanced or moved forwardly. Mounted in the housing 31 is a sheave 34, and passed around the said sheave is a cable 35, which at its ends is connected to lateral projections 36 on the guns at intermediate points in the length thereof. The said cable 35 serves to transmit positive motion from the gun that has been fired to the other gun, with the result that incidental to the recoil of the first-named gun the other gun will be positively moved forward to firing position. It will also be noticed here that the recoil of each gun will be taken up by the pull that it exerts in advancing the other gun, as well as by the force necessary to actuate the working parts hereinafter specifically described. I prefer, however, to employ in conjunction with the guns 32 and 33 the springs 37 and 38, shown in Fig. 1. The spring 37 is interposed between the forward portion of the housing 31 and the projection 36 on the gun 32 and has a tendency to expand. The spring 38 is of the retractile type and is connected at one end to the forward portion of the housing 31 and at its rear end to the projection 36 on the gun 33. My invention contemplates the firing of the gun 33 in the first instance, and it will be seen that incidental to the recoil of said gun 33 the spring 38 will be put under tension to cushion the rearward movement of the gun 33 while the attendant forward movement of the gun 32 will be cushioned by the compression of the spring 37. Then when the gun 32 is fired the tendency of the spring 37 to expand will assist in the rearward and even movement of the gun 32 and will be assisted in such function by the contraction of the spring 38, which will synchronously assist in the forward movement of the gun 33.

Fixed to and extending rearwardly from opposite sides of the housing 31 are arms 39, Figs. 1, 2 and 3, and pivoted to the rear

extremities of said arms 39 are inwardly directed links 40. These links 40 are pivotally connected at their inner ends and at the points 41 to swinging breech block carriages 42, which latter are pivotally connected at 43 to the guns. By virtue of this construction it will be manifest that when the gun 32 recoils its breech block carriage 42 will be opened as shown in Fig. 1, and at the same time and incidental to the forward movement of the gun 33, this breech block carriage 42 will be closed, also, as shown in Fig. 1, and that incidental to the recoil of the gun 33 and the forward movement of the gun 32, the breech block carriage of the former will be opened and the breech block carriage of the latter will be closed. In the breech of each gun is a mutilated thread 44, and mounted to turn about its axis in each carriage 42 is a breech block 45, having upon its perimeter a mutilated thread 46, complementary to the said thread 44, and best shown in Fig. 8. Each carriage 42 is chambered as indicated by 46' and 47, Fig. 5, and each breech block is provided with a rearwardly extending tubular portion 48, which is journaled to turn about its axis in its respective carriage 42. Disposed in each chamber 47 is a coil spring 49, which is connected to the adjacent tubular portion 48 at one end and has its opposite end fixed with respect to the adjacent carriage 42. The said springs 49 assist in the locking of the breech blocks 45 in the gun breeches and also hold the breech blocks under yielding pressure against the breeches. Fixed on the tubular portions 48 of the breech blocks 45 are cranks 50. See Fig. 3. These cranks 50 are connected to the rear ends of cables 51, which are carried around sheaves 52 mounted above the centers of movement of the carriages 42, and are connected at their forward ends to the rear portion of the guide housing 31. From this it follows that at the beginning of the rearward movement of each gun its respective block 45 will be turned about its axis against the torsional action of the spring 49, and will then be translated rearwardly by endwise expansion of the spring 49 into the forward recess 46' of the complementary carriage 42, and immediately thereafter the carriage will be swung open. It will be understood from this that the opening movement of the carriage does not attend but follows the initial portion of the recoil or rearward movement of the gun. Upon the forward movement of either gun, the carriage 42 thereof is closed, the breech block 45 thereof is translated forwardly against the endwise action of the spring 49, and then but not until then the spring 49 is enabled to turn the breech block 45 about its axis to lock it in the breech. In this way rotation of the breech block before the block is fully inserted in the gun bore is pre-

vented. In other words, the breech block must be moved forward from the chamber 46' before the spring 49 can turn the block.

Suitably fixed upon the carriage 18 and located in rear of and in alinement with the space between the guns 32 and 33 is a platform 60, having a cross head 61 at its rear end, and guided in said cross head 61 are longitudinally movable follower rods 62. These follower rods 62 are connected in a loose manner with the end portions of a swinging beam 63, which is fulcrumed at its center on the platform 60, as indicated by 64. Pivotally connected to the arms of the beam 63 are links 65, which are connected at their forward ends to the inner arms of levers 66. These levers 66 are fulcrumed on a transverse support 67 carried by the platform 60, and the outer arms of said levers 66 are connected to the rear ends of pitmen 67', the forward ends of which are pivotally connected to the breech portions of the guns. Thus when either rod 62 is moved forwardly its complementary follower rods 62 will be retracted or moved rearwardly, while coincident with the rearward movement of each gun its complementary follower rod 62 will be moved forwardly; the movements of the said parts being so timed that the breech mechanism of the guns may be operated as described, without interference from the follower rods 62. This will be better understood when it is stated that each carriage 42 is swung open past the path of the adjacent rod 62 before said rod in its forward movement reaches the transverse plane of the carriage 42.

Each gun is provided with an inner lateral projection 70, Figs. 1 and 4, and arranged on the carriage 18 in position to be engaged by said projection 70 is a longitudinally movable slide 71, which is yieldingly held in its forward position by a retractile spring 72 interposed between it and a portion of the carriage 18. Pivotally connected to the rear portion of the slide 71 is a pitman 73, which at its rear end is pivotally connected to an arm 74 loose upon an upright shaft 75, which shaft 75 has fixed upon it a ratchet 76 for the engagement of a pawl 77 carried by the arm 74. The upright shaft 75 is journaled in the carriage 18 and is equipped with a miter gear 78. By virtue of the parts described and relatively arranged as set forth, it will be manifest that coincident with the rearward movement of each gun, the slide 71 will be moved rearwardly and through the medium of the slide connections the shaft 75 will be turned a certain distance about its axis. When, however, the slide 71 is drawn forwardly by the contraction of the spring 72, the pawl 77 will ride idly over the teeth of the ratchet 76 and hence the said ratchet 76 and the shaft 75 will be left at rest. As best shown in Fig. 4, a miter pinion 80 on a

longitudinal shaft 81 is intermeshed with the gear 78, and the said shaft 81 is equipped with sprocket gears 82. Also carried by the carriage 18 is a lower longitudinal shaft 83 equipped with sprocket gears 84, and mounted on the sprocket gears 82 and 84 are sprocket belts 85, Figs. 1 and 3, upon which are carried in spaced relation longitudinally disposed shell cradles 86. One of the said shell cradles is shown in detail in Fig. 9, and by reference to said figure it will be observed that the resilient portion 87 of each cradle is adapted to extend outwardly beyond the center of a shell disposed in the cradle, with the result that there is no liability of the shell being laterally displaced through accident from the cradle. Also carried by the carriage 18 is a shell hopper 90, which is disposed, as shown, at the outer side of the standard 14. The said hopper 90 is provided with a discharge orifice 91, and with an inclined chute or bottom wall 92^a, which latter extends to a point adjacent to the traverse of the outer stretch of the conveyer. Arranged above and in spaced relation to the lower portion of the chute or hopper bottom 92^a is a star wheel 93^a. This star wheel is fixed upon a shaft 94^a and said shaft 94^a is provided with a spur gear 95^a, Fig. 1, intermeshed with a spur gear 96^a on the shaft 83, whereby, as will be manifest, the star wheel 93 will be rotated from and in concert with the lower conveyer shaft 83. As will be readily understood, the star wheel 93 has for its function to check and regulate the discharge of the shells between the hopper 90 and the outer stretch of the endless conveyer.

It will be gathered from the foregoing that the star wheel and the endless conveyer derive their motion from the recoil of the guns, and I would here have it understood that the scheme of my invention contemplates moving the star wheel and the conveyer the distance of two cradles 86 incidental to the recoil of each gun. This provision is made in order that when the outer stretch of the conveyer is moved forwardly, each forward movement will carry a shell into position in alinement with the righthand gun, and will carry another shell, indicated by *a* in Fig. 3, past the alined position with the bore of the righthand gun so that on the subsequent movement of the conveyer a distance corresponding to two of the cradles 86, the said shell *a* will be carried into alinement with the bore of the lefthand gun. The cradles 86 of the conveyer are adapted to give and pass either rod 62 when said rod is in its forward position at the time the conveyer is moved.

The shells 90', designed for use in my novel ordnance are of such character that the cases 91' of the shells are designed to be consumed and blown out of the guns when

the shells are exploded. Each shell 90' is provided at its rear end with two electrodes 92, and the breech block 45 complementary to each gun is provided with terminals 93, designed, when the block is closed, to make contact with the electrodes 92. The terminals 93 are electrically connected with wires 94, which are carried through the block 45 and the tubular extension 48 thereof and are designed to be arranged in normally open circuits with sources of electric energy 94', shown diagrammatically in Fig. 4. Also included in the said electric circuits are terminals 95 carried by the guns, and spring cushioned terminals 96 carried by the housing 31. From this it follows that when each gun is advanced to the firing position the terminals 95 of its respective circuit contacting with the terminals 96 will complete the electric circuit complementary to the gun, with the result that a spark will be formed between the electrodes 92, and the shell in the gun will be exploded.

It will be noted from the foregoing that an attendant, by reason of my novel construction, is enabled to traverse the guns and elevate and depress the muzzles thereof with the expenditure of little effort; also, that when the hopper 90 is properly charged with a quota of shells and the firing of the guns is commenced by manual completion of the electric circuit complementary to the gun 33, the shell in the right-hand gun 33 will be fired in the first instance. It being noticed here that the spring 38 will have moved the gun 33 to its foremost position. Thereafter, and so long as the operation continues, the operation of the guns, and the several elements that derive motion from the movement of the guns, will be automatic. Manifestly, however, the operation may be discontinued at any time desired by manipulating the electric switches 99 to interrupt the electric circuits.

Notwithstanding the automatic capacity and the other advantages ascribed to my improvement in ordnance, it will be appreciated that the improvement is simple and compact in construction, and that all of its parts are well adapted to withstand the shocks and strains to which the parts of rapid-firing ordnance are ordinarily subjected.

The construction herein shown and described constitutes the best practical embodiment of my invention that I have as yet devised, but I would have it understood that in the future practice of the invention various changes in the form and relative arrangement of the parts may be made without involving departure from the scope of my invention as defined in my appended claims.

Having described my invention, what I

claim and desire to secure by Letters Patent, is:

1. The combination of supporting means, a gun carriage mounted to swing vertically in the supporting means and having at its ends grooved convex portions, a transverse shaft journaled in the supporting means, sprocket gears fixed on said shaft in the same planes as the sides of the carriage, means for transmitting rotary motion to said shaft, idlers mounted in the supporting means and arranged in the same planes as said sprocket gears, and sprocket cables connected at their ends to the upper portions of the sides of the carriage at the ends thereof and adapted to rest in the grooved portions of the carriage; said cables being passed around said idlers and being provided with bights arranged over and engaged by said sprocket gears.

2. The combination of supporting means, a carriage mounted to swing vertically on said means, ammunition supply means carried by and movable with the carriage as a unit; said ammunition supply means comprising a hopper, a conveyer and feed regulating means actuatable from the conveyer, guns mounted to move rectilinearly in the carriage, means whereby the recoil of one gun is utilized to advance the other gun, projections on the guns, an upright shaft mounted in the carriage, and connected with the conveyer of the ammunition supply means, a ratchet on said shaft, an arm loose with respect to the shaft and having a pawl for cooperation with said ratchet, a longitudinally movable slide connected with said arm and adapted to be moved rearwardly by the projections on the guns, and a spring for moving said slide forwardly.

3. The combination of supporting means, a carriage mounted to swing vertically on said means, ammunition supply means carried by and movable with the carriage as a unit; said ammunition supply means comprising a hopper, a conveyer and feed regulating means actuatable from the conveyer, guns mounted to move rectilinearly in the carriage, means whereby the recoil of one gun is utilized to advance the other gun, projections on the guns, an upright shaft mounted in the carriage, and connected with the conveyer of the ammunition supply means, a ratchet on said shaft, an arm loose with respect to the shaft and having a pawl for cooperation with said ratchet, a longitudinally movable slide connected with said arm and adapted to be moved rearwardly by the projections on the guns, a spring for moving said slide forwardly, a beam pivoted at an intermediate point of its length on the rear portion of the carriage, levers fulcrumed at intermediate points in their length on the rear portions of the carriage, longitudinally movable fol-

lower rods connected to the arms of the beam, links connecting the inner arms of the levers and the arms of the beams, and pitmans interposed between and connecting the outer arms of the levers and the breech portions of the guns.

4. The combination of supporting means, a carriage mounted to swing vertically on said means, ammunition supply means carried by and movable with the carriage as a unit; said ammunition supply means comprising a hopper, a conveyer and feed regulating means actuatable from the conveyer guns mounted to move rectilinearly in the carriage, means whereby the recoil of one gun is utilized to advance the other gun, projections on the guns, an upright shaft mounted in the carriage, and connected with the conveyer of the ammunition supply means, a ratchet on said shaft, an arm loose with respect to the shaft and having a pawl for coöperation with said ratchet, a longitudinally movable slide connected with said arm and adapted to be moved rearwardly by the projections on the guns, a spring for moving the slide forwardly, longitudinally movable follower rods, means mounted on the carriage and connected with the breech portions of the guns for moving one follower rod forwardly when the other is retracted and vice versa, arms fixed to the carriage and disposed alongside the breech portions of the guns, breech mechanisms complementary to the guns and, respectively, comprising a breech block carriage and a rectilinearly movable and rolling breech block in the carriage, connections between said arms and the breech block carriages for opening and closing the latter incidental to movement of the guns, means connected with the gun carriage and the breech blocks for turning said blocks about their axes incidental to rearward movement of the guns, and means for turning the breech blocks about their axes in the opposite direction and for translating the breech blocks.

5. The combination of a gun carriage having a guide housing, guns movable rectilinearly in said housing, a sheave mounted in the housing, a cable passed around said sheave and connected at its ends with the guns whereby the recoil of one gun will tend to move the other gun forwardly, a cushion spring interposed between one gun and the forward portion of the housing, and a retractile spring connected at its forward end to the forward portion of the housing and at its rear end to the other gun.

6. The combination of a gun carriage having a guide housing, guns movable recti-

linearly in said housing, a sheave mounted in the housing, a cable passed around said sheave and connected at its ends to the guns, a spring for cushioning the forward movement of one gun, a spring for cushioning the rearward movement of the other gun, ammunition supply means, means for transmitting motion to the ammunition supply means, and tappets on the guns and adapted to actuate said motion-transmitting means.

7. The combination of supporting means, a carriage mounted to swing vertically therein, ammunition supply means comprising a hopper connected with the carriage and arranged exteriorly of the supporting means, a conveyer, a regulating means intermediate the hopper and the conveyer and driven from the latter, guns movable rectilinearly in the carriage, means constructed and arranged to advance one gun synchronously with the recoil of the other, and means constructed and arranged to actuate the conveyer and the regulating means of the ammunition supply means in a step by step manner incidental to the recoil of each gun.

8. The combination of a gun carriage having a guide housing, guns movable rectilinearly in said housing and connected together, whereby the recoil of one gun will be attended by forward movement of the other gun to firing position, shells for use in the guns and each having spaced electrodes, terminals on the guns and terminals on the said guide housing; the said electrodes in the shells and the said terminals complementary to the guns and the guide housing being arranged in normally open circuits with a source of electric energy, whereby when each gun is moved forwardly to firing position a spark will be formed between the electrodes of the shell in the gun and said shell will be exploded.

9. The combination of a gun having a mutilated thread in its breech, a breech block carriage hinged on the breech portion of the gun, a breech block movable rectilinearly about its axis in the carriage, and having a mutilated thread, a spring surrounding a portion of said block and connected at one end to the block and at its opposite end to the carriage, means for opening the carriage on the recoil movement of the gun and for closing the carriage on the forward movement of the gun, and means for translating and rolling the breech block on rear and forward movements of the gun.

In testimony whereof I have affixed my signature.

LEONARDO PACILLI.