Oct. 25, 1949. W. M. CUTLER 2,486,008

DRILL GUN

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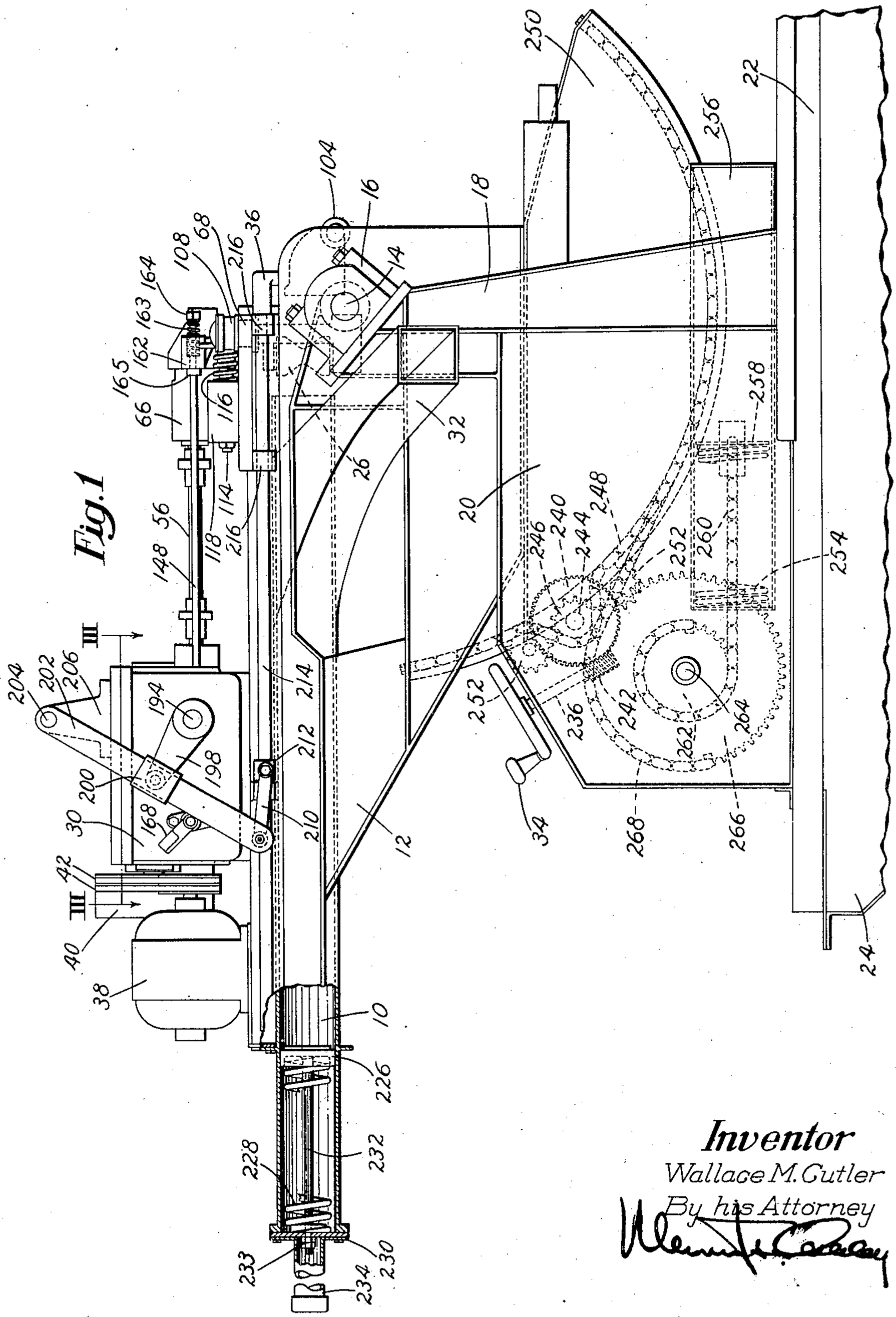
Fig. 1



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DRILL GUN

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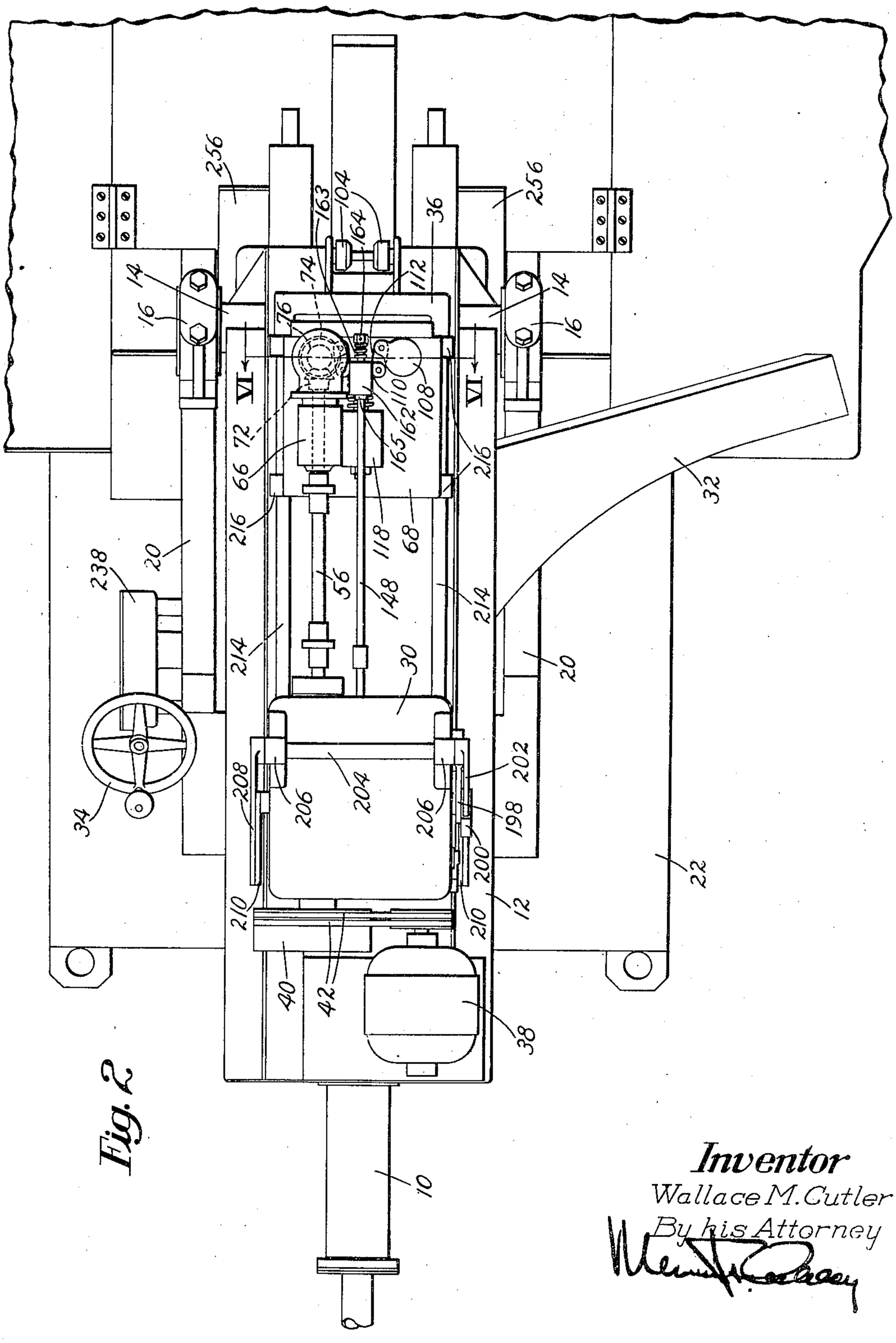

Fig. 2

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Fig. 3

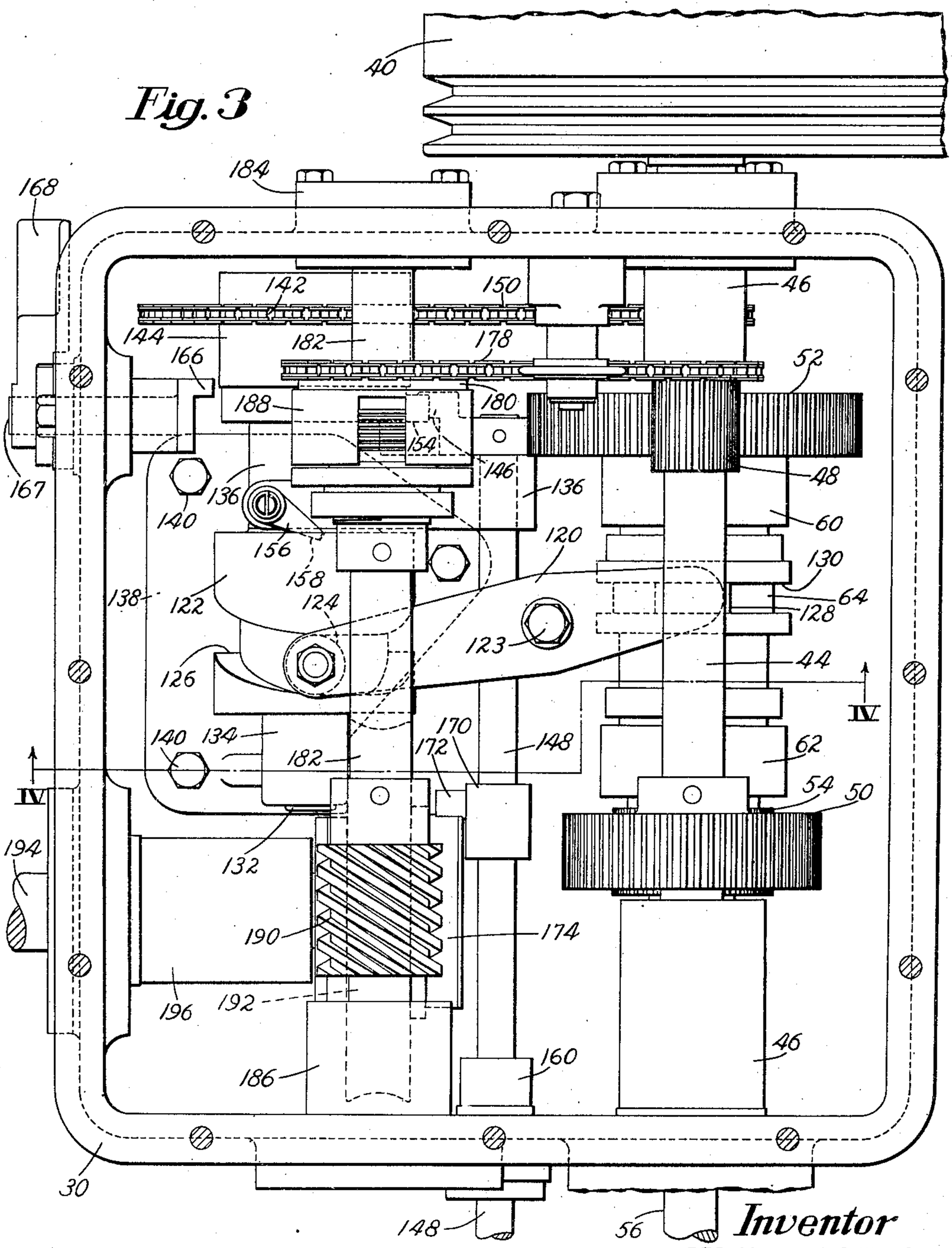

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Fig. 4.

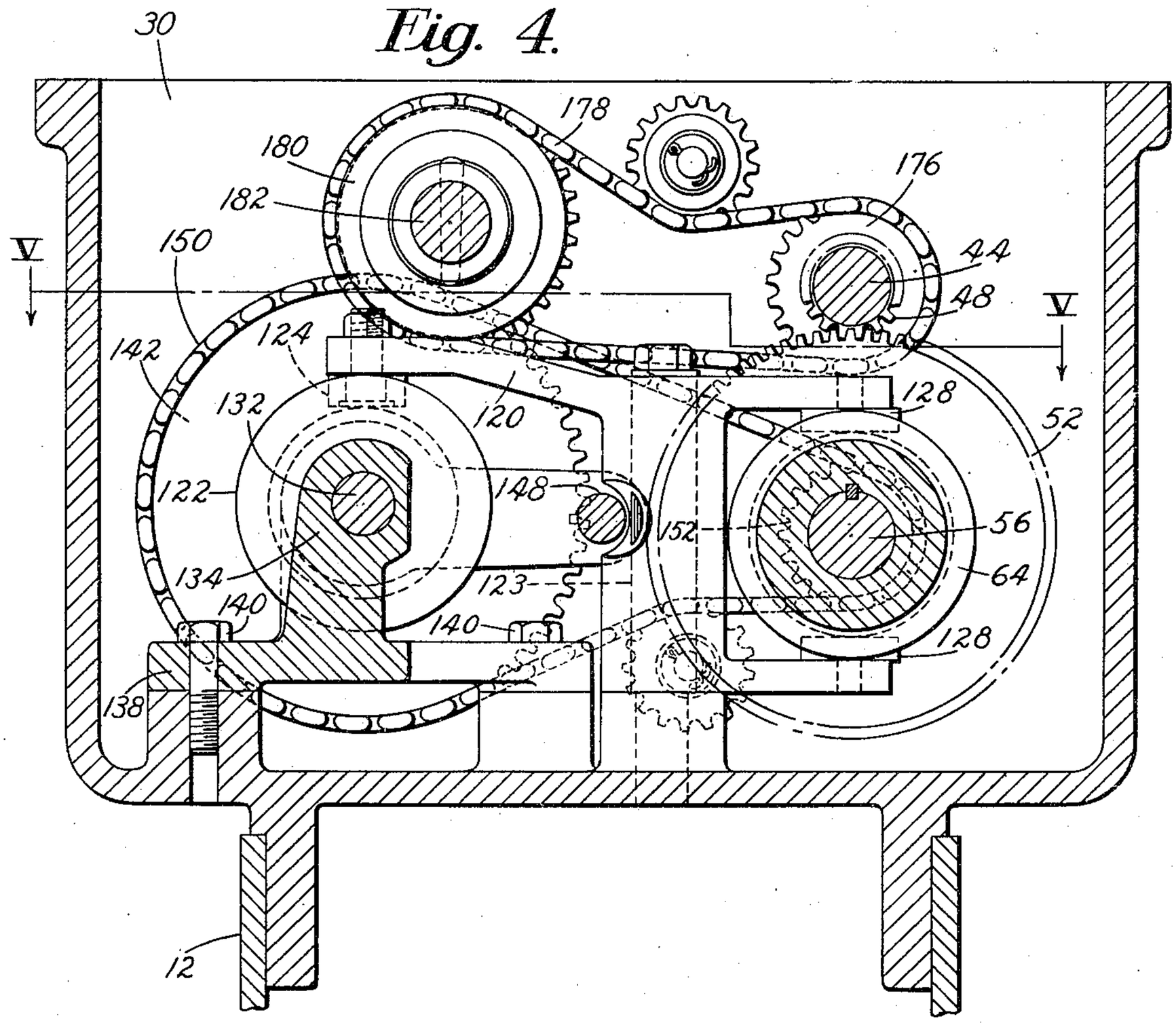

Fig. 8.

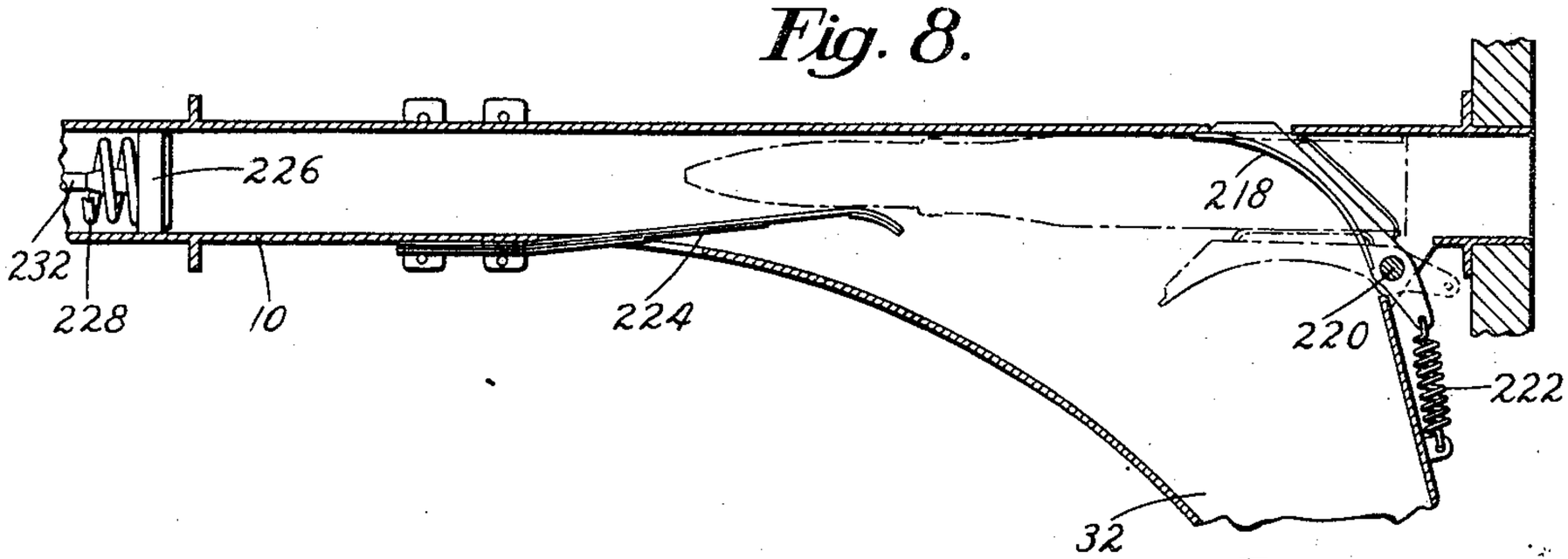

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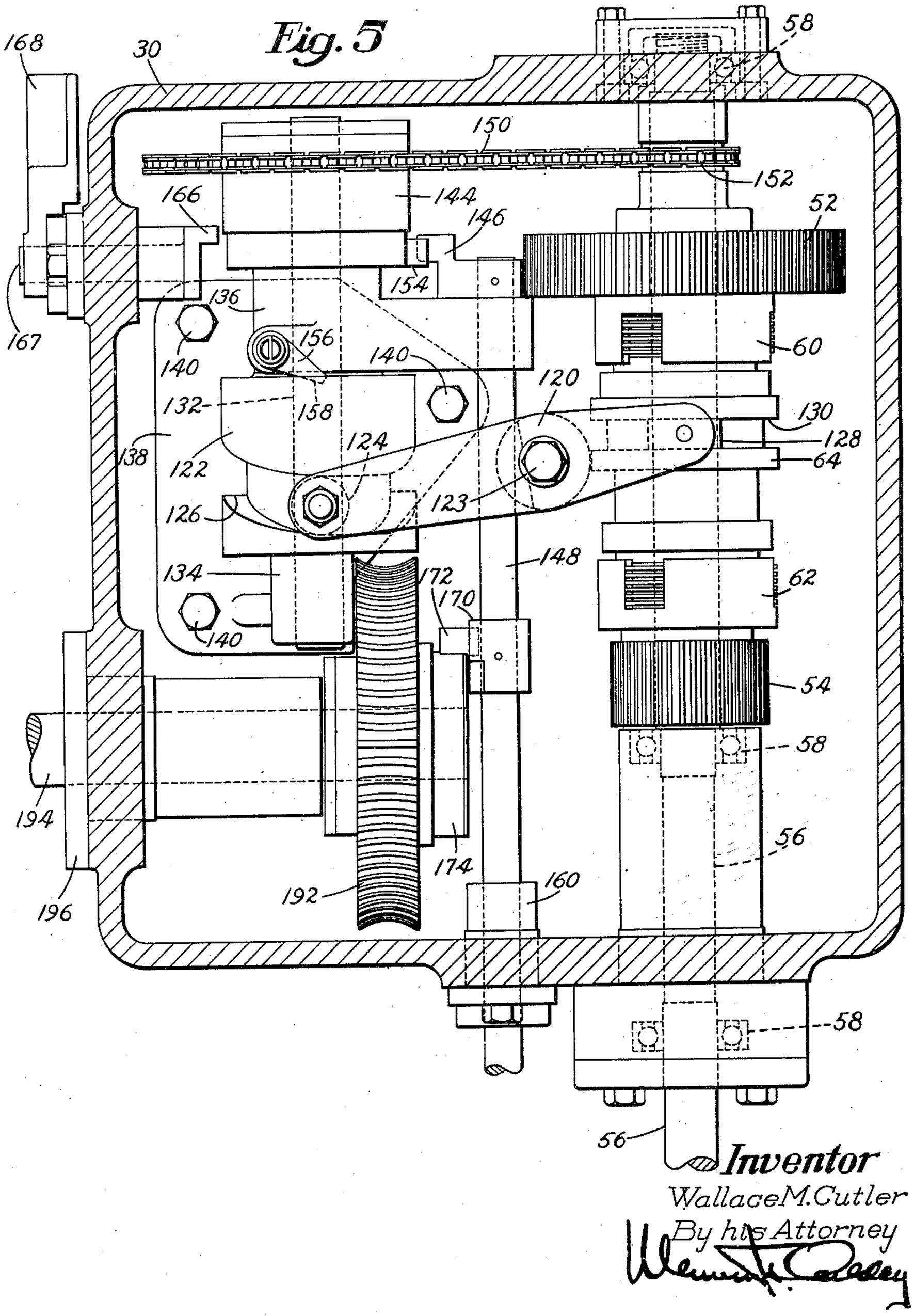
Fig. 5



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DRILL GUN

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Fig. 7.

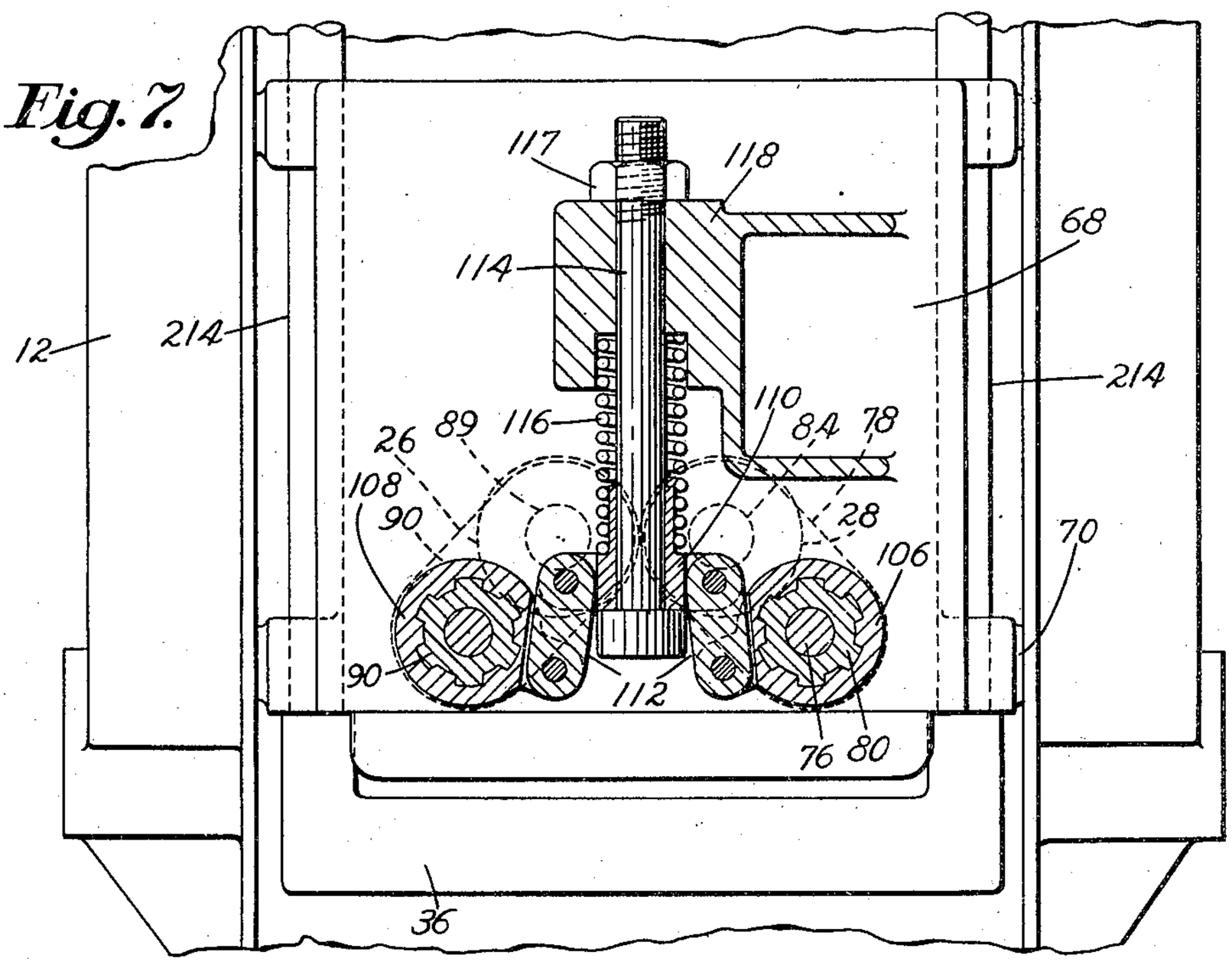
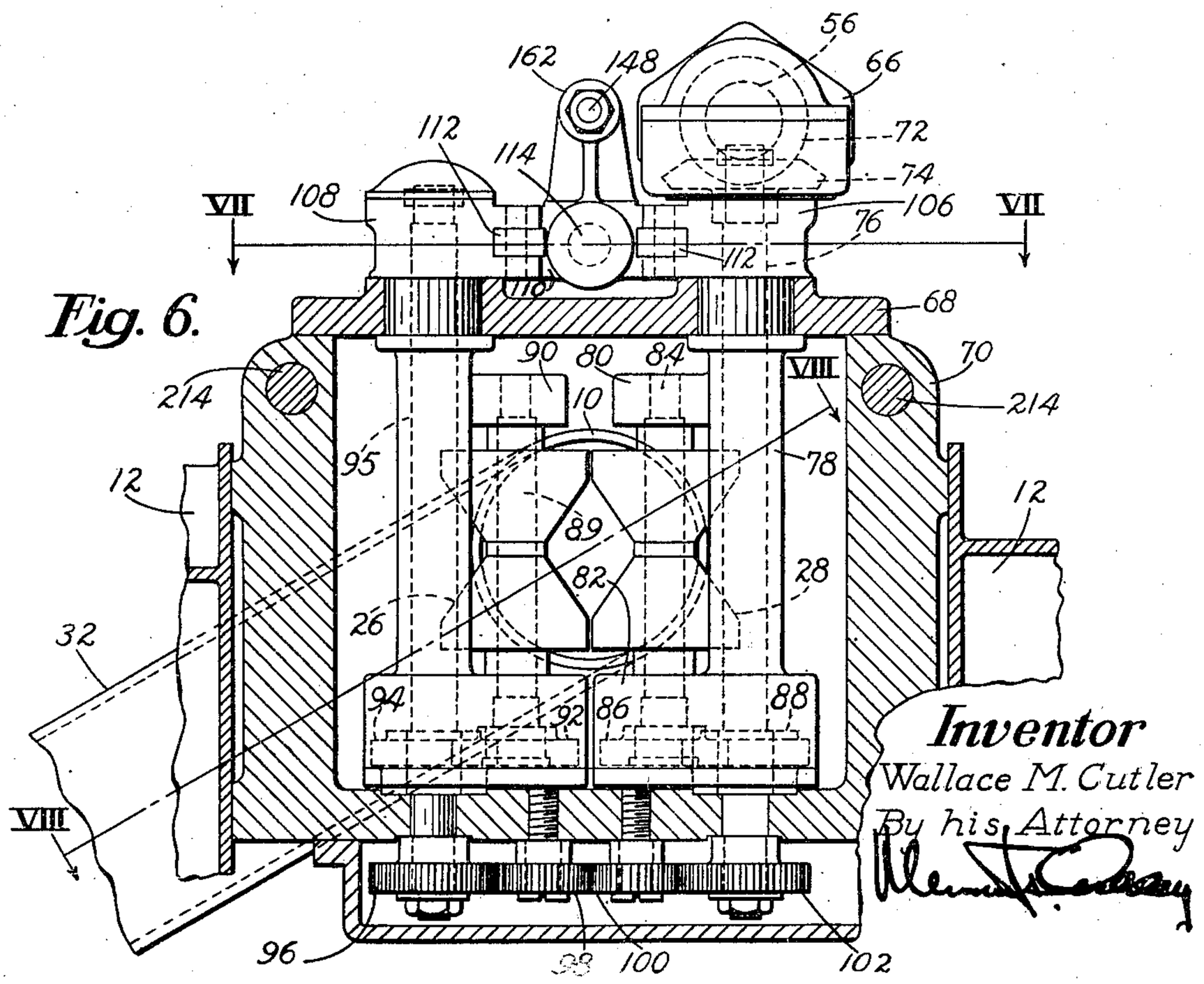


Fig. 6.



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Patented Oct. 25, 1949

2,486,008

UNITED STATES PATENT OFFICE

2,486,008

DRILL GUN

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Application April 24, 1946, Serial No. 664,612

9 Claims. (Cl. 35—25)

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This invention relates to training devices and more particularly to a drill gun for use in training personnel to load an actual gun.

The efficient loading of a gun commonly requires well-timed ammunition-passing operations on the part of several men. All ammunition passers must work together and in synchronism with the operating cycle of the gun in order to attain a high rate of fire. Since the loading cycle may vary, depending upon whether it includes a fuse-setting period, the gun crew should also be trained to function in different loading rhythms, as well as to avoid the danger of injury from the recoil of the gun.

In view of the foregoing, an object of the invention is to provide an improved drill gun requiring a minimum of dummy ammunition and the operational features of which, relating to loading, are similar to its prototype.

To this end, the illustrated gun is actuated by the presentation of a dummy shell thereto to project or ram the shell into the barrel and to simulate recoil, all with substantially the same speed and timing as that of the prototype.

In order to simulate the loading cycle of an actual gun when it includes a fuse-setting operation, provision is made in the illustrated gun for interrupting the forward movement of the shell into the gun for the period required to set a fuse and then automatically completing the movement of the shell.

The illustrated gun is also constructed and arranged to stop the forward movement of the shell and to utilize this movement immediately to return the shell to a convenient position, outside the gun, for handling by the first ammunition passer.

These and other objects and features will now be described in detail with reference to the accompanying drawings and will be pointed out in the appended claims.

In the drawings,

Fig. 1 is a side elevation of an illustrative drill gun embodying the invention;

Fig. 2 is a plan view of the drill gun shown in Fig. 1;

Fig. 3 is a plan view of the transmission box with its top removed at the level indicated by the line III—III in Fig. 1;

Fig. 4 is a sectional elevation of the transmission box, the section being taken along the line IV—IV in Fig. 3;

Fig. 5 is a sectional plan view of the transmission box, the section being taken along the line V—V in Fig. 4;

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Fig. 6 is a sectional end view of the breech end of the drill gun showing the ramming mechanism, the section being taken along the line VI—VI in Fig. 2;

Fig. 7 is a sectional plan view of the mechanism illustrated in Fig. 6, the section being taken along the line VII—VII in Fig. 6;

Fig. 8 is a fragmentary sectional view of a part of the gun barrel and ejector chute, the section being taken in a plane including the axes of the barrel and chute.

The illustrated drill gun comprises a barrel assembly including a tubular barrel 10 (Figs. 1 and 2) which is fixed to a housing 12 having trunnions 14 at the rear end thereof. The trunnions are rotatably mounted in bearings 16, 16 which are fixed to the upper ends of arms 18, 18 arranged to extend upwardly from frames 20, the latter being the counterpart of the usual gun carriage. The frames 20 are supported by a platform 22 the shape of which conforms to that of the prototype of the drill gun. The gun is adapted to be moved about on skids 24 which are fixed to the bottom of the platform.

The barrel assembly also includes a pair of rolls 26, 28 (Figs. 1, 6 and 7) which may be driven at one or more speeds through connections including a transmission box 30 which is mounted on the housing 12 above the barrel 10. A dummy round of ammunition, upon being presented between the rolls 26, 28, is projected into the barrel 10 with the same speed and timing as an actual round is loaded into the prototype of the drill gun. The forward movement of the dummy round is arrested and reversed in the barrel 10, as a result of which the round is ejected from the gun through an ejector chute 32 (Figs. 1 and 2) which is inclined downwardly and rearwardly from the barrel. The round is to be caught by one of the gun crew in training and is again to be passed through the rolls 26, 28. This procedure may be continued for as long as may be necessary thoroughly to acquaint the gun crew with the firing cycle of the gun. Further to simulate the operating conditions of an actual gun the barrel 10 may be elevated, by turning a hand wheel 34, through a range extending from a few degrees of depression to an elevation of 90°. Furthermore, the recoil of an actual gun is simulated by a recoil-like movement of a breech simulating member 36 at the breech end of the barrel 10, which member is moved rearwardly in timed relation to the forward movement of the round.

Power for driving the rolls 26 and 28 is provided by an electric motor 38 (Figs. 1 and 2) which

is fixed to the forward end of the housing 12 and drives a fly wheel 40 through belts 42. The fly wheel is fixed to a shaft 44 (Figs. 3 and 4) which is rotatably mounted in bearings 46, 46 in the ends of the transmission box. Fixed to the shaft 44 are a pinion 48 and a gear 50 which mesh with a gear 52 and a pinion 54 respectively, the last-mentioned gear and pinion being rotatably mounted on another shaft 56 (Fig. 5) which is directly below the shaft 44. The shaft 56 is rotatably mounted in the transmission box 30 on ball bearings 58, 58 and extends rearwardly of the gun to drive the rolls 26, 28. Associated with the gear 52 and pinion 54 are clutches 60 and 62, respectively, which may be selectively engaged with or disengaged from a quill 64. The quill is keyed to the shaft 56 and is movable axially of the shaft to establish a driving connection between the shaft and either the gear 52 or the pinion 54. As will be explained hereinafter, low and high speeds of the shaft 56 are utilized in succession, with an intervening period of stalling, when a loading cycle including a fuse setting operation is to be simulated. If the cycle is not to include a simulated fuse setting interval, only the high speed driving connections involving the gear 50 and pinion 54 are utilized.

The rear end of the shaft 56 is rotatably mounted in a bracket 66 (Figs. 2 and 6) which is integral with a cover 68 for a casing 70 which houses the rolls 26, 28. These rolls are driven by the shaft 56 through connections including a bevel-pinion 72 fixed to the shaft and adapted to mesh with a bevel-gear 74, the latter being fixed to the upper end of a vertical shaft 76 rotatably mounted within a yoke 78. The yoke 78 has an upper arm 80 and a lower arm 82 in which is rotatably mounted a shaft 84 to which the roll 28 is fixed. The shaft 84 is driven from the shaft 76 by gears 86 and 88 which are fixed to the lower ends of these shafts. In a similar fashion, the roll 26 is carried by a shaft 89 which is rotatably mounted on another yoke 90 and is driven by a gear 92 fixed to its lower end. A gear 94, meshing with the gear 92, is fixed to a shaft 95 which is rotatably mounted within the yoke 90. The shaft 95 is driven from the shaft 76 by a gear train comprising a gear 96 fixed to the lower end of the shaft 95, idler gears 98 and 100 rotatably mounted in the base of the casing 70, and a gear 102 which is fixed to the lower end of the shaft 76.

When a dummy round is presented to the gun, the nose of the round is directed into the opening between the rolls 26 and 28 provided by their V-shaped contour. This operation is facilitated by a pair of guide rolls 104 (Figs. 1 and 2) which are rotatably mounted on the rear end of the casing 70 in such a position as to aline the axis of the round with that of the barrel. The rolls 26 and 28 are made of rubber or other similar yielding material and have serrated surfaces which are adapted to grip the nose of the round and project the latter into the barrel. The normal opening between the rolls is so narrow as to admit only the end of the round. However, as the forward movement of the round begins the rolls are separated by the round owing to its gradually increasing diameter, but maintain a yielding pressure upon the round. This action of the rolls is permitted by the rotatable mounting of the yokes 80 and 90 is the casing 70. The yokes, whenever thus moved, swing oppositely to each other and in equal amounts under the control of connections including cranks 106, 108 (Figs. 6 and 7) which are splined to the upper ends of the yokes 80 and

90 respectively and are connected to a slide 110 by links 112. The slide 110 is normally held yieldingly against the head of a stud 114 by a coil spring 116, the stud being mounted in a bracket 118 which is integral with the cover 68. It is evident that the spring 116 provides the yielding pressure of the rolls 26, 28 against the round. The normal spacing of the rolls 26, 28 in their closed position can be adjusted by setting up an adjusting nut 117 which is threaded on the forward end of the stud 114.

At the beginning of a cycle in the operation of the gun the rolls 26 and 28 are rotated at about 116 R. P. M., providing a shell speed of about 130 feet per minute. The quill 64 (Figs. 3 and 5) at this time is held in engagement with the clutch element 60 and the low speed drive is effected through the gear and pinion 52 and 48. As the round progresses between the rolls 26 and 28 the increasing diameter of the round separates the rolls as explained above, and the corresponding movement of the yokes 80 and 90 is utilized, when a fuse setting operation is to be simulated, first to disengage the quill 64 from the clutch element 60 whereby the rolls 26 and 28 are stalled for a short period, and then to engage the quill with the clutch element 62 whereby the rolls are driven at an increased speed of about 996 R. P. M. providing a shell speed of about 830 feet per minute.

The quill 64 is operated in the manner described above by a lever 120 which is operated by a cam 122. This cam is rotated through one revolution for each cycle of operation of the gun. The lever 120 is pivoted on a stud 123 which is fixed to the transmission box 30 and at one end carries a roll follower 124 which is received in a groove 126 in the cam 122. Pivoted on the other forked end of the lever 120 (Fig. 4) are a pair of swivel blocks 128 which are received in a groove 130 in the quill 64. The cam 122 is fixed to a shaft 132 which is rotatably mounted in bearings 134, 136 arranged to extend upwardly from a pad 138. The pad is secured to the base of the transmission box by bolts 140. A sprocket 142 and a well-known rolling-pin type of clutch 144 are mounted together on the forward end of the shaft 132. The clutch is under the control of a detent 146, the latter being fixed to the forward end of a control shaft 148. A chain 150 drives the sprocket 142 and is driven by another sprocket 152 which is keyed to the shaft 56. At the beginning of an operating cycle the detent 146 (Fig. 5) holds the actuating member 154 of the clutch 144 in its inoperative position against spring tension. Reverse movement of the shaft 132 and clutch 144 (which this spring tension tends to cause) is prevented by a pawl 156 which is pivotally mounted on the bearing 136 and is yieldingly seated in a notch 158 in the cam.

The control shaft 148 is arranged to slide axially in the bearing 136 and another bearing 160 in the rear end of the transmission box, the shaft at its rear end being connected to an arm 162 (Figs. 1 and 6) integral with and extending upwardly from the slide 110. The shaft 148 is yieldingly held in its normal extreme rearward position by a spring 163 which seats in a recess in the arm 162 and abuts a nut 164 threaded in the end of the shaft. The shaft 148 is positively operated, to actuate the above-mentioned clutches, by the engagement of the arm 162 with a collar 165 which is adjustably fixed to the shaft in such a position as to cause the clutches to be actuated at the desired times with reference to the progress of the round between the rolls 26, 28.

Shortly after the initial forward movement of the round has begun (for example, at the time when the usual bulge in the projectile passes the rolls), the lateral operating movement of the rolls will have moved the slide **110**, and hence the control shaft **148**, far enough rearwardly to remove the detent **146** (Fig. 5) from engagement with the actuating member **154**. Thus, the actuating member permits the clutch **144** to become engaged with the shaft **132** and the cam **122** now begins its rotation through one complete revolution.

The shape of the cam groove **126** is such that the lever **120** is first moved to disengage the clutch **60** and to hold the lever **120** so that the quill **64** is out of operative relation to either the clutch **60** or the clutch **62** for a short period of time in the order of 2½ seconds. The forward movement of the round is stopped during this period since the rolls **26** and **28** are stalled by the friction between all the parts connecting the quill **64** with the rolls **26**, **28** and a fuse setting operation is simulated. As soon as the dwell in the cam groove **126** has passed the roll **124**, the shape of the groove is such as to move the lever **120** to engage the quill **64** with the clutch **62** whereby the rolls are driven at their high speed. Toward the completion of one revolution of the cam **122** the round will have passed beyond the rolls **26** and **28**, allowing the control shaft **148** to move rearwardly under the influence of the spring **116**. The detent **146** is thus again brought into the path of the member **154**. When the latter engages the detent **146** the clutch **144** will be disengaged from the shaft **132**. Shortly before the end of a cycle the quill **64** is moved out of engagement with the clutch **62** and into engagement with the clutch **60** whereby the initial low speed movement of the rolls **26** and **28** is resumed preparatory to a succeeding cycle of operation.

If the cycle of operation of the gun is not to include a fuse setting period, provision is made for operating the illustrated gun continuously at high speed. For setting the gun to operate in this fashion, a second detent **166** is adapted to be rotated into the path of the member **154** in a position opposite to the detent **146**. The detent **166** is formed on a shaft **167** which is rotatably mounted at the side of the transmission box and is operated by a control handle **168**. It will now be apparent that when the member **154** strikes the detent **166** rotation of the cam **122** will be stopped. At this time the cam will have moved the lever **120** to engage the quill **64** with the clutch **62** and until the handle **168** is operated to remove the detent **166** from engagement with the member **154** the rolls will be operated at high speed.

At a predetermined time in the passage of the round between the rolls **26** and **28** a simulated recoil movement is imparted to the breech simulating member **36** regardless of whether the operating cycle of the gun includes the simulated fuse setting period or not. At a time when the round has nearly passed the rolls **26** and **28** (as, for example, when the rim of the flange of the shell case engages the rolls), the control shaft **148** will have been given an additional forward movement sufficient to disengage a detent **170** (Figs. 3 and 5), which is mounted on the shaft, from the actuating pin **172** of a one-revolution clutch **174**.

At this point, the clutch **174** completes the driving relation between connections, which will presently be described in detail, for imparting a complete reciprocation of about two feet in length to the member **36**. A sprocket **176** (Fig. 4), which is fixed to the shaft **44** adjacent to the pinion **48**,

drives a chain **178** which runs over another sprocket **180**. The latter sprocket is rotatably mounted on a shaft **182** which runs in bearings **184** and **186** at opposite ends of the transmission box **30**. Associated with the sprocket **180** is a clutch **188** which delivers a limited but sufficient torque to the shaft **182** to drive the member **36**. However, the clutch will slip if the member **36** meets any opposition, as would happen if one of the gun crew were in the path of the member.

A worm **190** is fixed to the rear end of the shaft **182** and meshes with a worm gear **192** (Fig. 5) which is associated with the clutch **174**. The gear **192** is rotatably mounted on a shaft **194** which is journaled in a bearing **196** at one side of the transmission box. The outer end of the shaft **194** carries an arm **198** (Figs. 1 and 2) on the end of which is pivotally mounted a slotted block **200**. This block is arranged slidably to receive a lever **202** which is fixed to one end of a shaft **204**, the shaft being rotatably mounted in a pair of uprights **206** mounted on top of the transmission box. A second lever **208**, similar to the above-mentioned lever **202**, is fixed to the other end of the shaft **204**. The lower ends of the levers **202** and **208** are pivoted to links **210** which themselves are pivoted to blocks **212**, the latter being adjustably fixed to slide rods **214**, one rod being disposed at each side of the barrel assembly. The rods are supported for sliding movement parallel to the barrel **10** in bearings **216** formed integral with the casing **70**. The member **36** is fixed to the rear ends of the rods **214**, this member being so shaped as to traverse during its recoil simulating movement a danger area behind the drill gun similar to that in the prototype resulting from its own recoil. It will now be understood that when the clutch **174** is tripped the arm **198** will be rotated through one complete revolution thereby oscillating the levers **202** and **204**, first rearwardly and then forwardly, whereby a simulated recoil movement is imparted to the breech simulating member **36**.

As the dummy round is projected into the barrel **10** from the rolls **26** and **28**, it passes a gate **218** (Fig. 8) which is pivoted at **220** to the ejector chute **32** so as to move out of the way of the round. A spring **222** normally holds the gate closed against the barrel **10**. The gate is thus opened (to its broken line position in Fig. 8) by the passage of the round and later closes to its full line position in which it provides a curved extension to the rear side of the chute **32** which closes the barrel **10** with regard to reverse movement of the round. The round during its forward movement is urged toward the right-hand side of the barrel **10** not only by the gate **218** but also by a leaf spring **224** which is mounted at the junction of the chute **32** and the barrel **10**, as illustrated in Fig. 8. The forward motion of the round is arrested and then reversed shortly after the nose of the round strikes a plunger **226** (Fig. 1) which is mounted to yield axially of the barrel **10** under the influence of a spring **228**. This spring at one end abuts the plunger **226** and at the other end is seated on a cap **230** fixed to the end of the barrel **10**. A rod **232** is fixed to the plunger **226**, passes freely through an opening in the cap **230** and has a pair of lock nuts **233** threaded thereon which may be adjusted to provide any desired initial compression in the spring **228**. The outer end of the rod **232** is housed by a tube **234** which is fixed to the cap **230**. It will now be understood that after forward motion of the dummy round has been arrested, a reverrse

movement is imparted to the round by the expansion of the spring 228, whereupon the round again passes the spring 224 (Fig. 8) and is deflected by the gate 218 out of the barrel 10 and into the ejector chute 32. As the round emerges from the chute it is to be caught by a member of the gun crew and presented again to the rolls 26, 28.

Effective training in gun loading involves practice with the gun at various elevations since it generally becomes more and more difficult to load a gun as its elevation increases. The elevation of the illustrated gun may be changed, with the above purpose in view, by turning the hand wheel 34 (Figs. 1 and 2) which operate elevating mechanism now to be described.

The hand wheel 34 is fixed to the upper end of a shaft 236 (Fig. 1) which is rotatably mounted in a gear box 238 (Fig. 2) extending outwardly from the right-hand frame 20. The gear box houses a worm gear 240 (Fig. 1) which meshes with a worm 242 carried by the shaft 236. The gear 240 is fixed to a shaft 244 which is mounted to rotate in bearings (not shown) in the frames 20. Secured to the shaft 244 in the central portion thereof is a pair of closely spaced sprockets 246 over which run a pair of chains 248. These chains are wrapped around the cylindrical periphery of a quadrant 250 which is attached to the housing 12 and therefore moves with it about the axis of the trunnions 14. Idler sprockets 252 are arranged to keep the chains 248 taut and at the same time to insure a substantial angle of engagement between the chains and the sprocket 246. The quadrant 250 is of sufficient extent to permit the gun to be moved in elevation from a position of a few degrees of depression to an elevation of 90°. In order to render as uniform as possible the force required to move the gun in elevation at any part of its range of movement, the gun is counterbalanced by a pair of springs 254 which are spaced at equal distances from the quadrant laterally thereof. The springs are housed in tubes 256 which are fixed to the inner sides of the frames 20. Each spring 254 seats at its forward end on a closure at the forward end of each tube. The rear end of each spring is engaged by a seat 258 which is arranged to slide freely within its tube 256. Each of two chains 260 is attached at one end to one of the seats 258, extends out of the forward end of the tube and is wrapped about and attached to a sprocket 262. The sprockets 262 are fixed to a shaft 264 which also carries another pair of closely spaced sprockets 266 and is journaled at its opposite ends in the frames 20. Wrapped about and fixed to the sprockets 266 are a pair of chains 268 which also are wrapped about and fixed to the periphery of the quadrant 250 close beside the chains 248. It will now be apparent that as the gun is raised in elevation from its position as illustrated in Fig. 1, the seat 258 will be permitted to move rearwardly within the tube 256, whereby the compression of the spring is reduced in accordance with the diminished moment of the weight of the gun about the trunnions 14.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. A drill gun having a breech simulating member, mechanism for projecting a shell into said gun, recoil means for imparting a recoil simulating movement to said member, and control means operated by the shell during its movement into said gun for actuating said recoil means.

2. In a drill gun having a breech simulating member, mechanism comprising opposed members mounted for separating movement to receive a shell therebetween, said opposed members also being mounted for rotative movement together to project the shell into the gun, recoil means for imparting a recoil simulating movement to said breech simulating member, and control means operated by the separating movement of said opposed members for actuating said recoil means.

3. In a drill gun having a breech simulating member, rolls mounted to swing away from each other to receive a shell presented therebetween, driving means for rotating said rolls whereby the shell is projected into said gun, recoil means for imparting a recoil simulating movement to said breech simulating member, and means operated by the separating movement of said rolls for actuating said recoil means.

4. A drill gun comprising a breech simulating member, opposed rolls mounted for separating movement to receive a shell therebetween, driving means for rotating said rolls to project the shell into said gun, recoil means for imparting a recoil simulating movement to said breech simulating member, and means operated by the separating movement of said rolls for interrupting the operation of said driving means for a period equivalent to that required by a fuse-setting operation and for then actuating said recoil means.

5. In a drill gun, a barrel, opposed members mounted for separating movement to receive a shell therebetween, driving connections for operating said members to project the shell into said barrel, and means actuated by the separating movement of said members successively to disengage and reengage said driving connections whereby the movement of the shell into said barrel is interrupted by a period of rest equivalent to that required by a fuse-setting operation.

6. In a drill gun, a barrel, mechanism for projecting a shell into said barrel, means for driving said mechanism said means comprising low-speed and high-speed connections, and means operated by the shell in response to its movement into said barrel for disengaging said low-speed connections and then engaging said high-speed connections thereby to provide discontinuous forward movements of the shell separated by a period of rest equivalent to a fuse-setting period.

7. In a drill gun having a breech simulating member, a barrel, a pair of separable rolls adapted to receive a shell therebetween, recoil mechanism for imparting a recoil simulating movement to said breech simulating member, driving mechanism comprising low-speed and high-speed driving connections for rotating said rolls, means for disengaging said low-speed connections to stop said rolls whereby a fuse-setting period is simulated and then engaging said high-speed connections whereby the shell is projected into the barrel, and means for engaging said recoil mechanism with said driving mechanism after the engagement of said high-speed connections.

8. In a drill gun, a barrel, an ejector chute associated with said barrel, mechanism for projecting a shell into said barrel, a plunger in said barrel constructed and arranged yieldingly to arrest and reverse the movement of said shell, and a gate normally disposed across said barrel for directing the shell in its reverse movement from said barrel into said chute.

9. In a drill gun, a barrel having an ejector chute associated therewith, mechanism for projecting a shell into said barrel, a yielding stop in said barrel for arresting the initial movement of

the shell and imparting a reverse movement thereto, and a gate normally disposed across said barrel for directing the shell in its reverse movement from said barrel into said chute, said gate being mounted to swing out of the path of the shell during its initial movement.

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