Aug. 27, 1963 C. W. GREENE 3,101,647

AMMUNITION HANDLING APPARATUS

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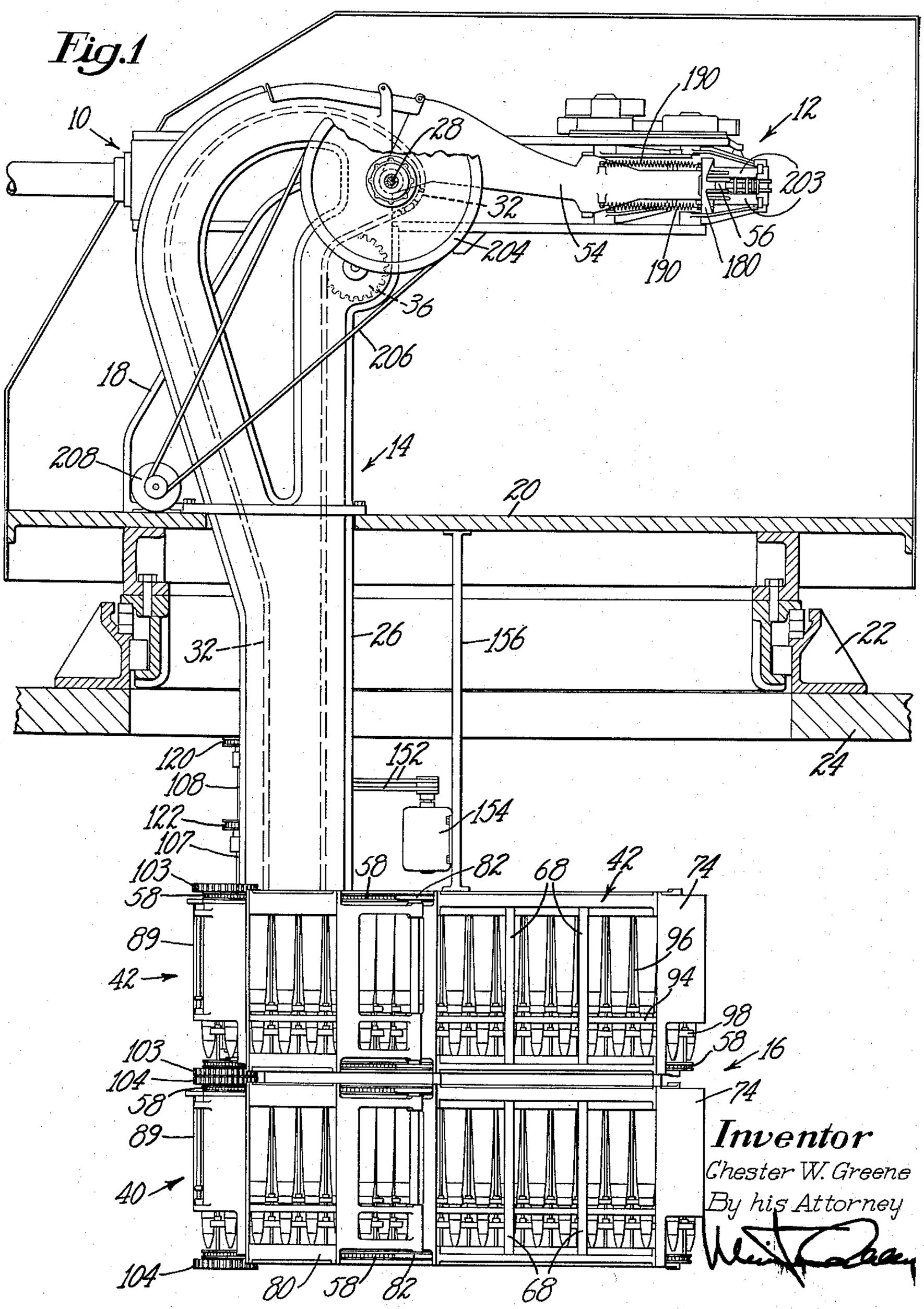
Fig. 1



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By his Attorney

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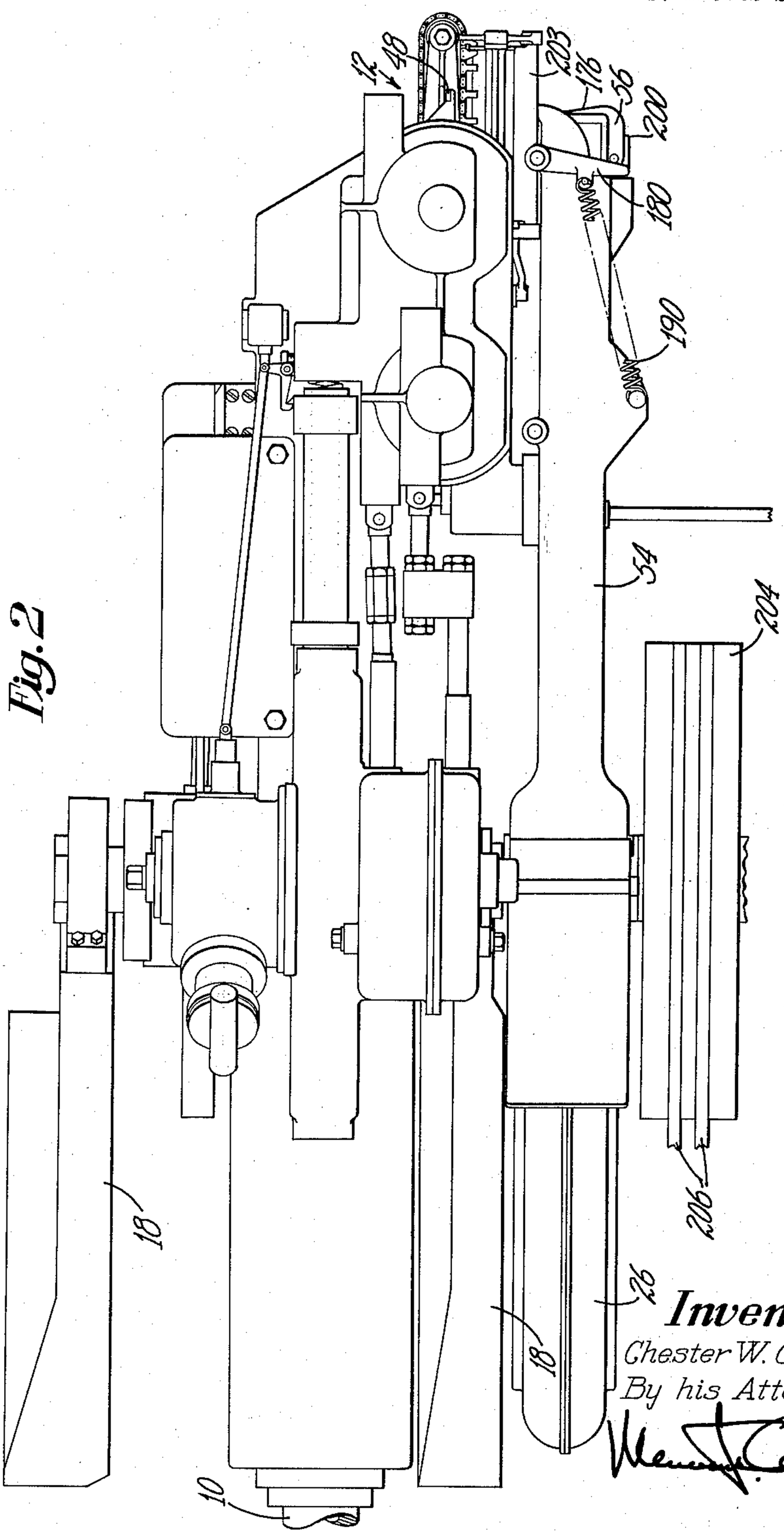

Fig. 2

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Fig. 3

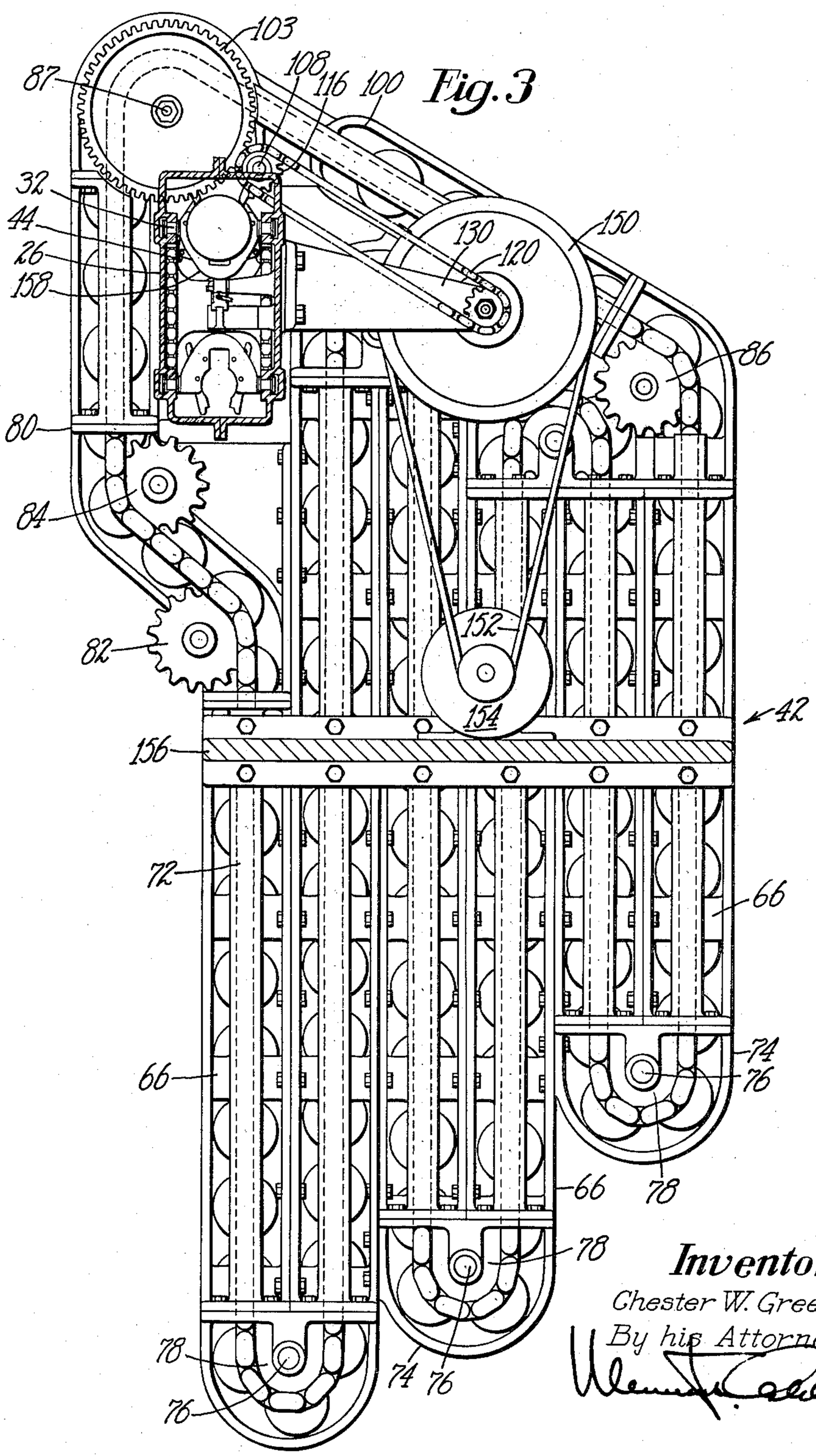

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Fig. 4

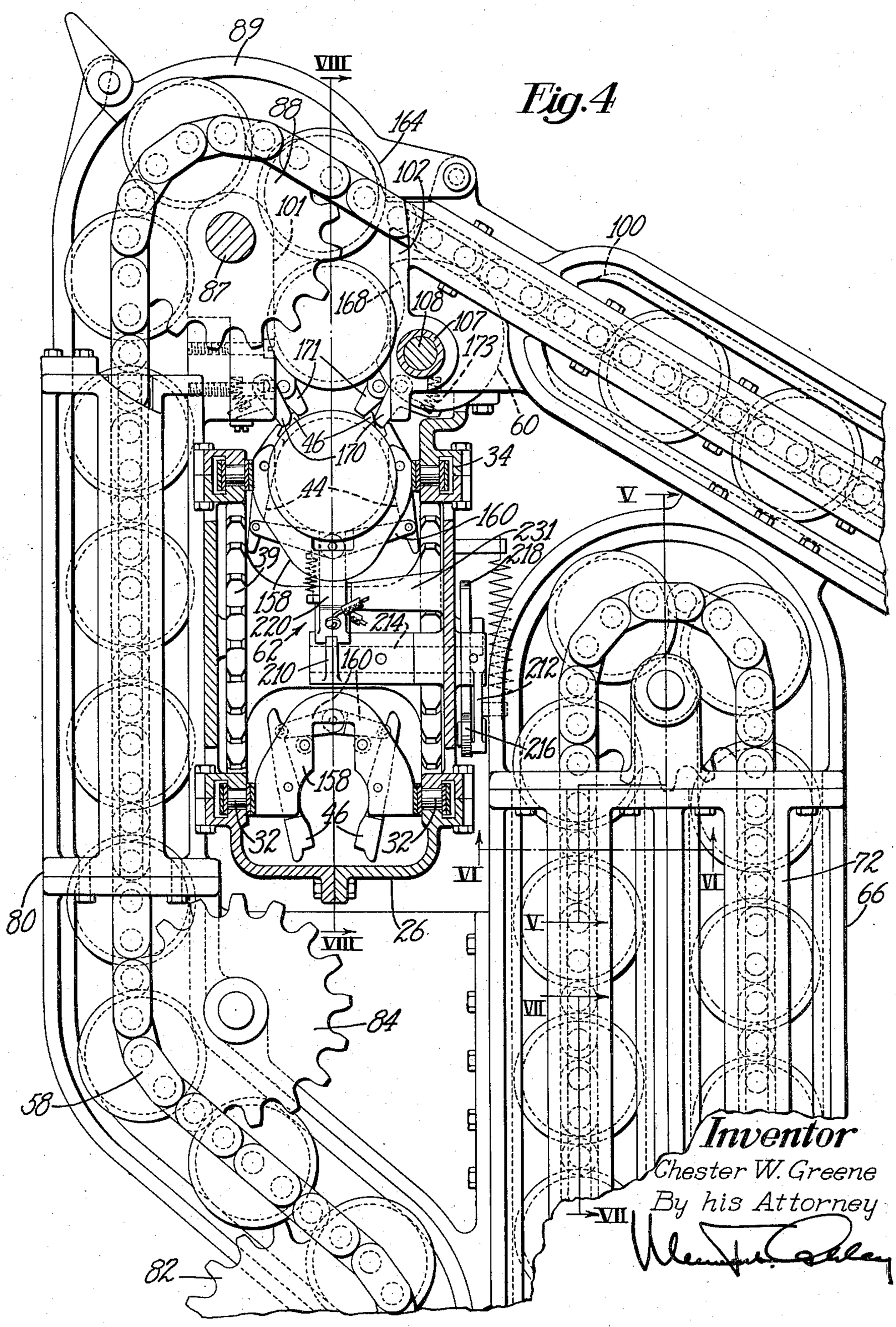

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Fig. 6

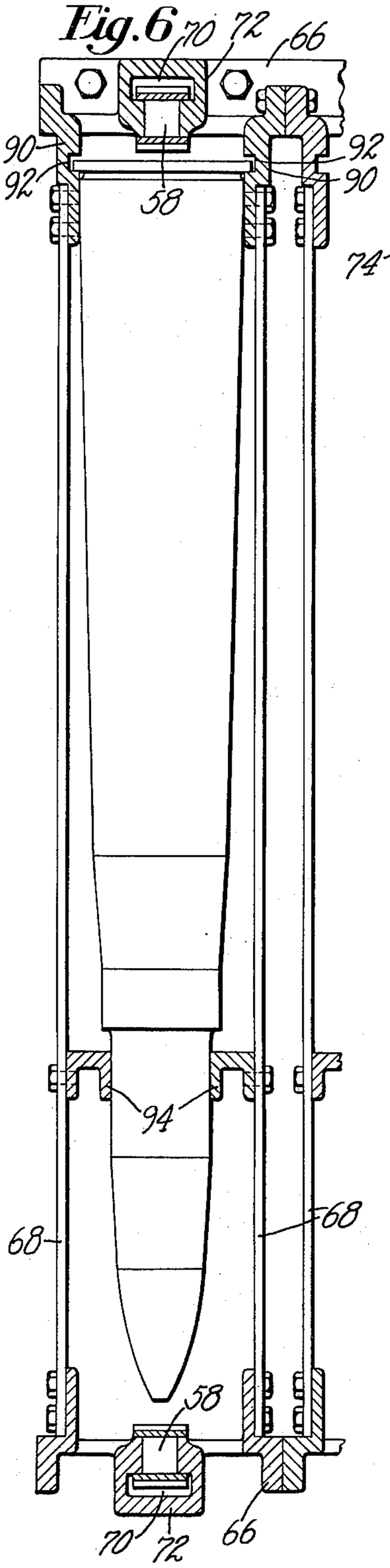

Fig. 5

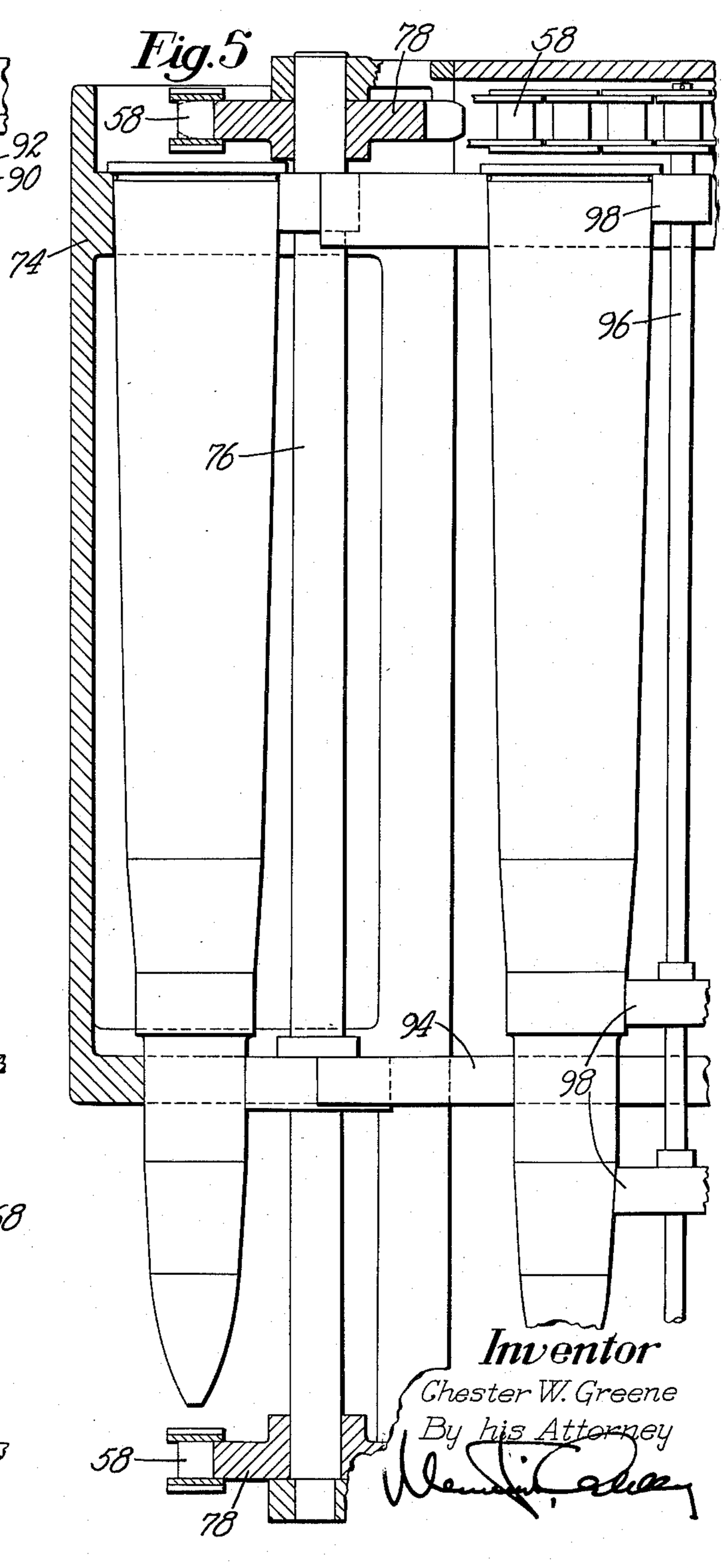

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Fig. 7

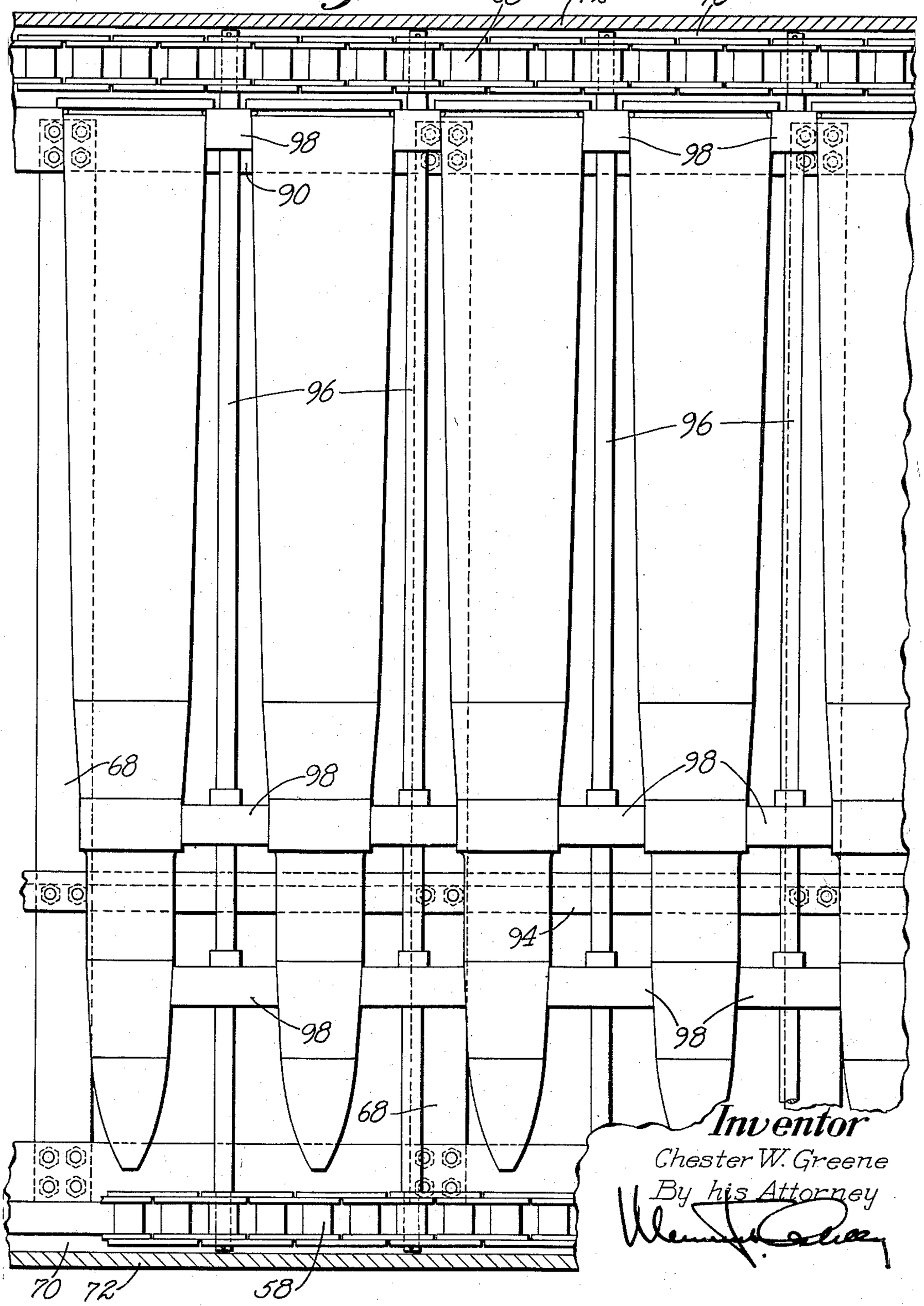

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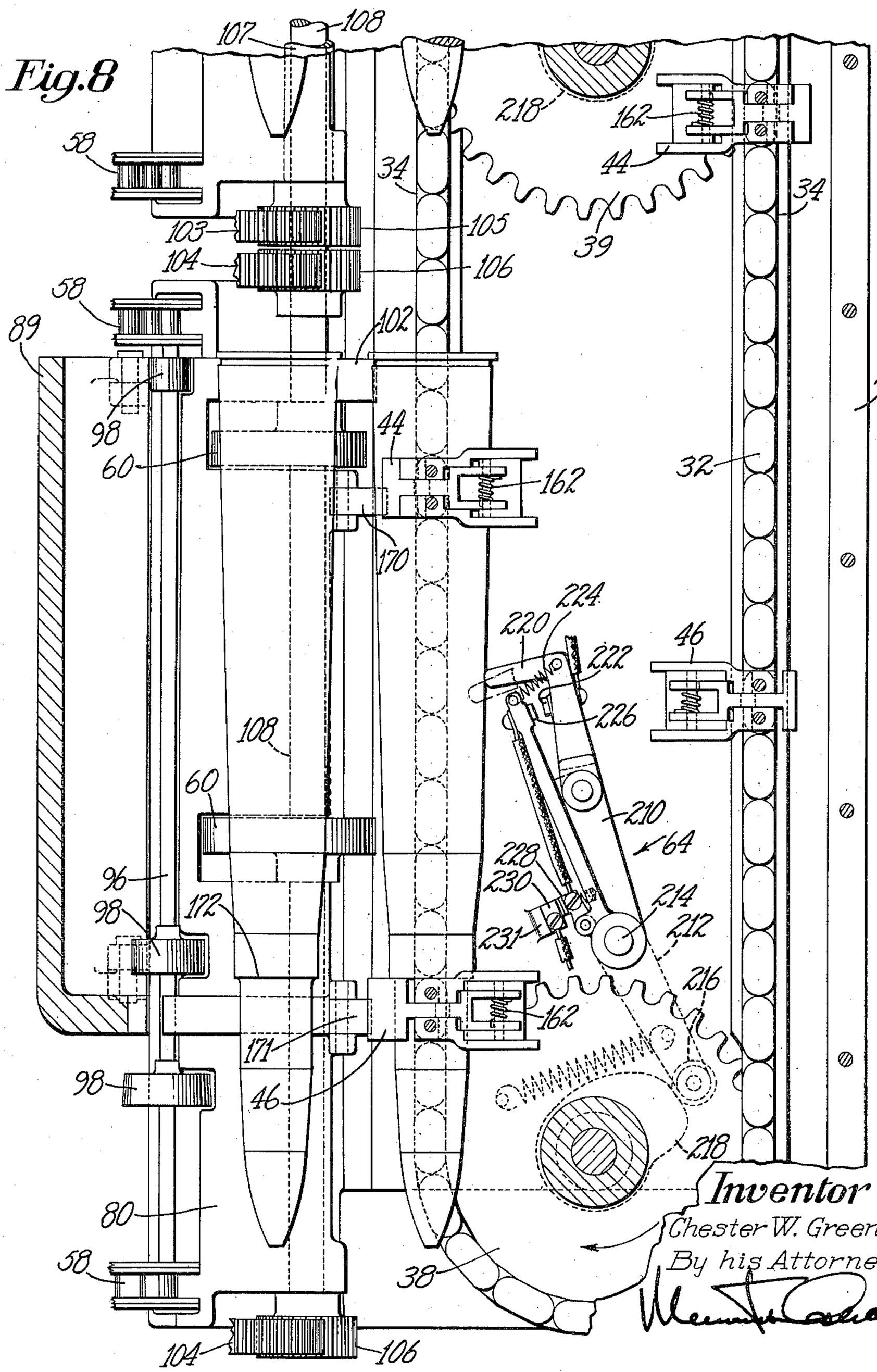
Fig. 8



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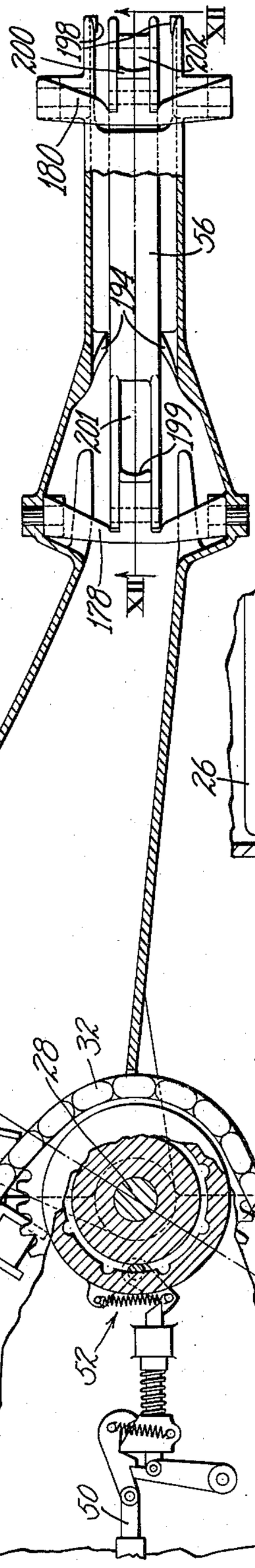

Fig. 9

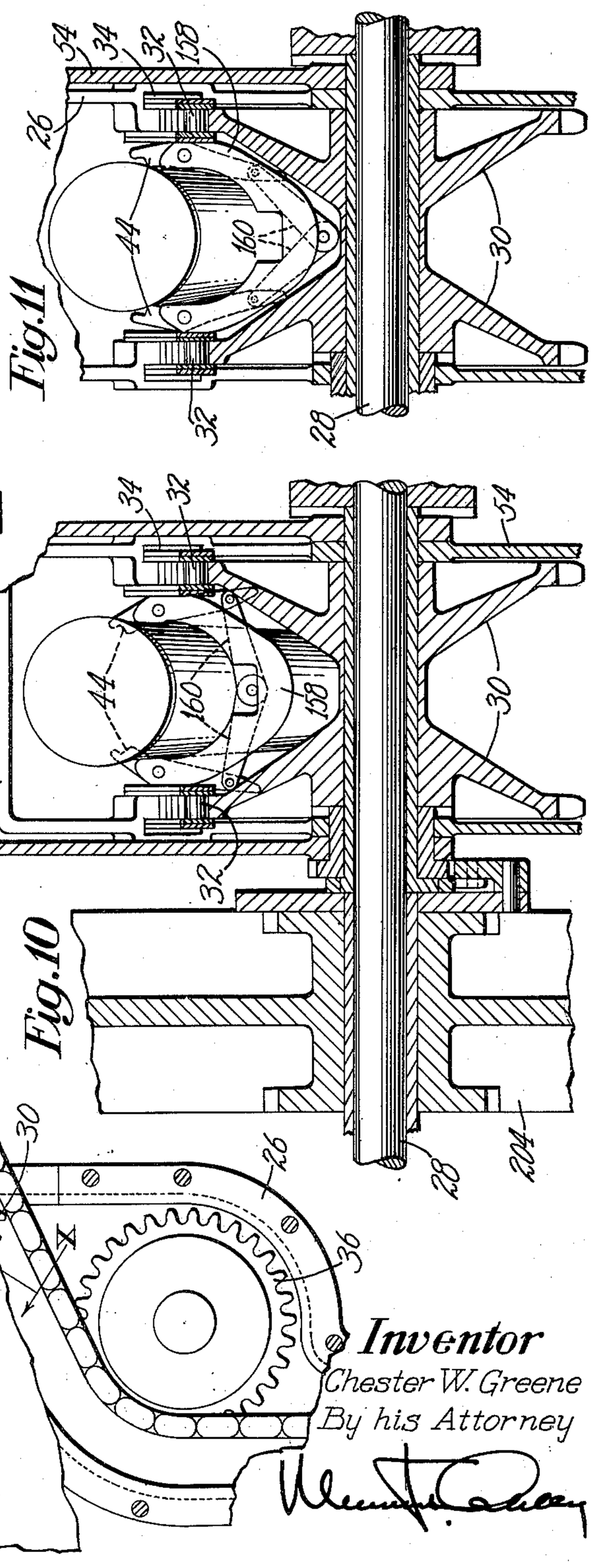

Fig. 11

Fig. 10

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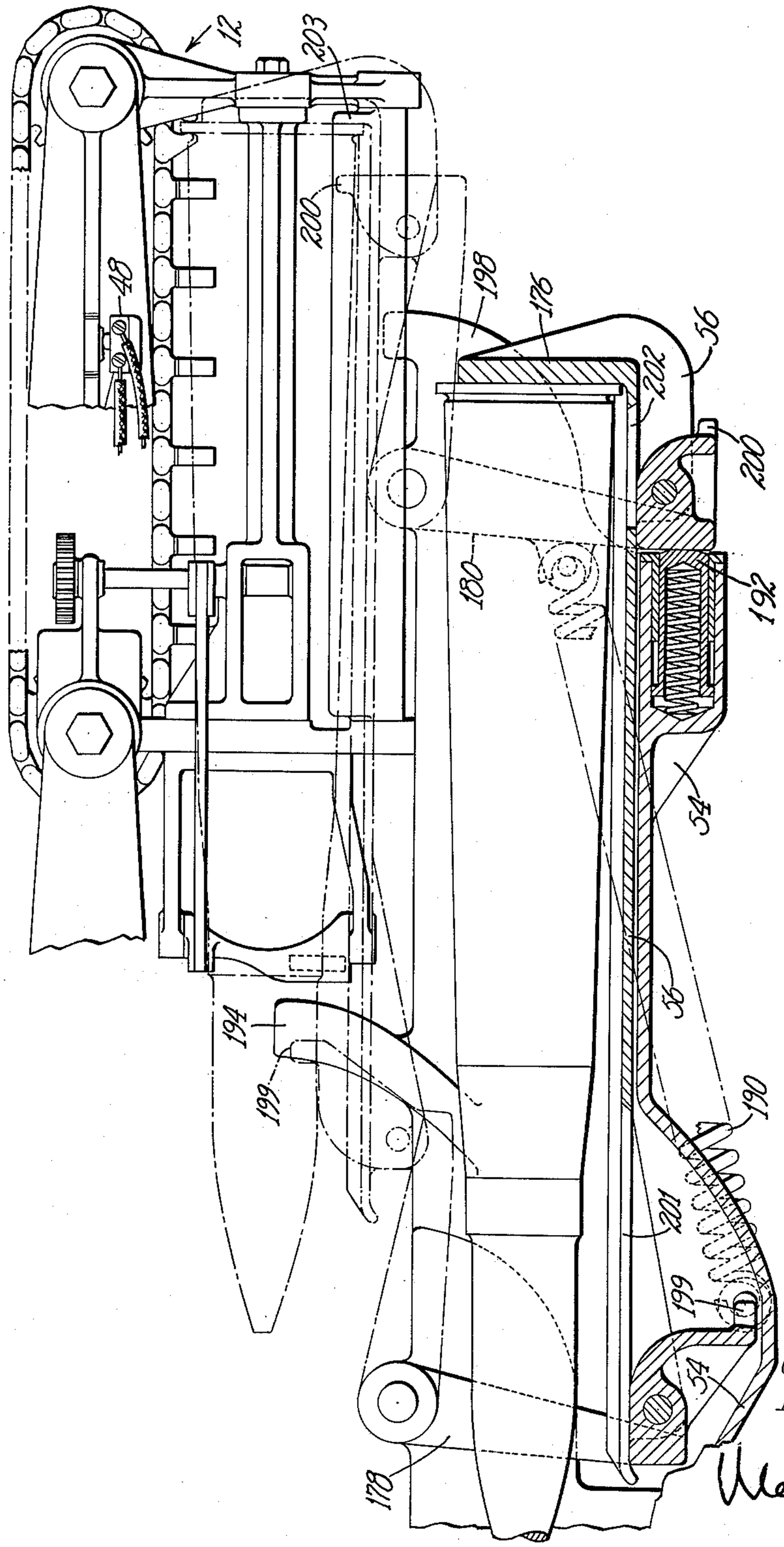

Fig. 12

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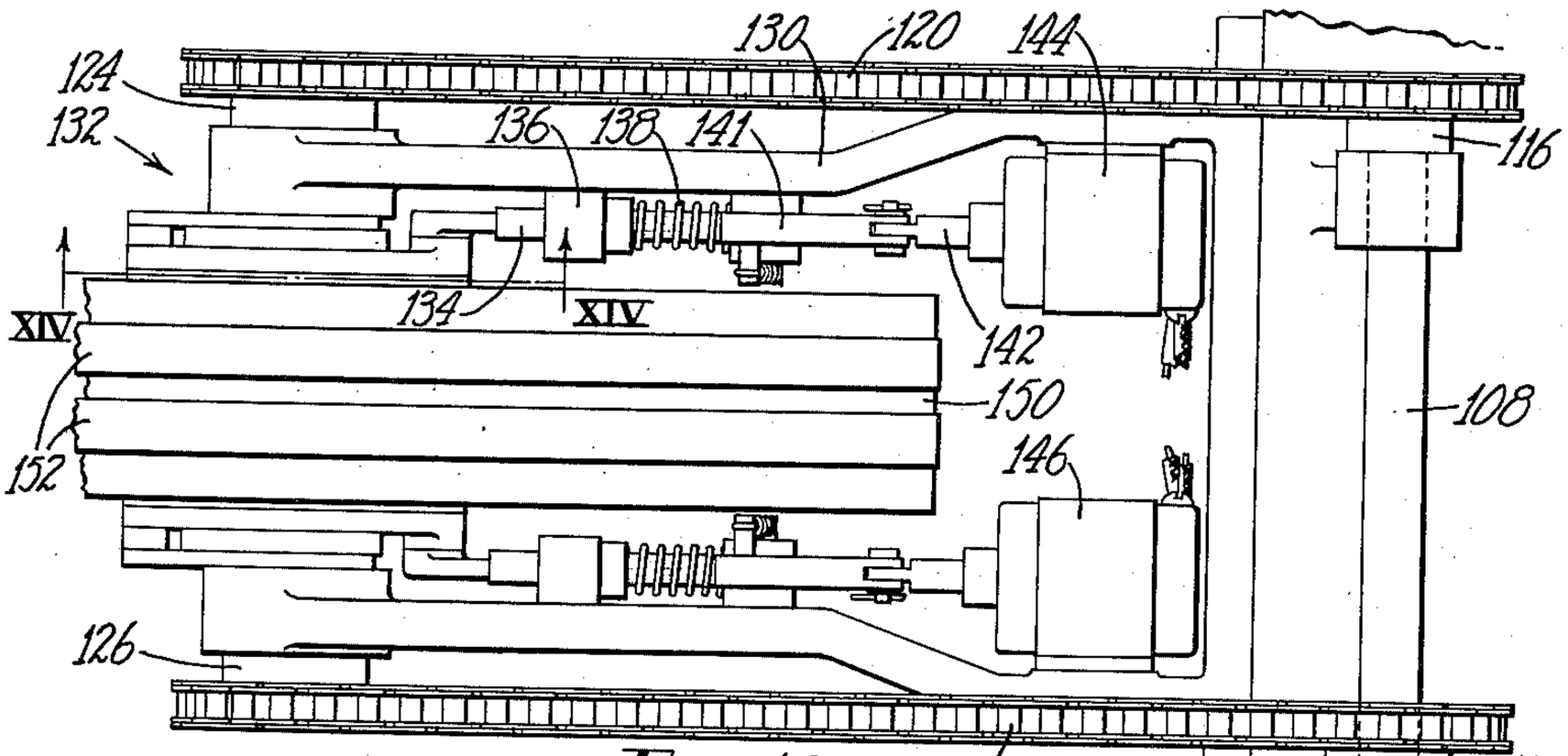


Fig. 13

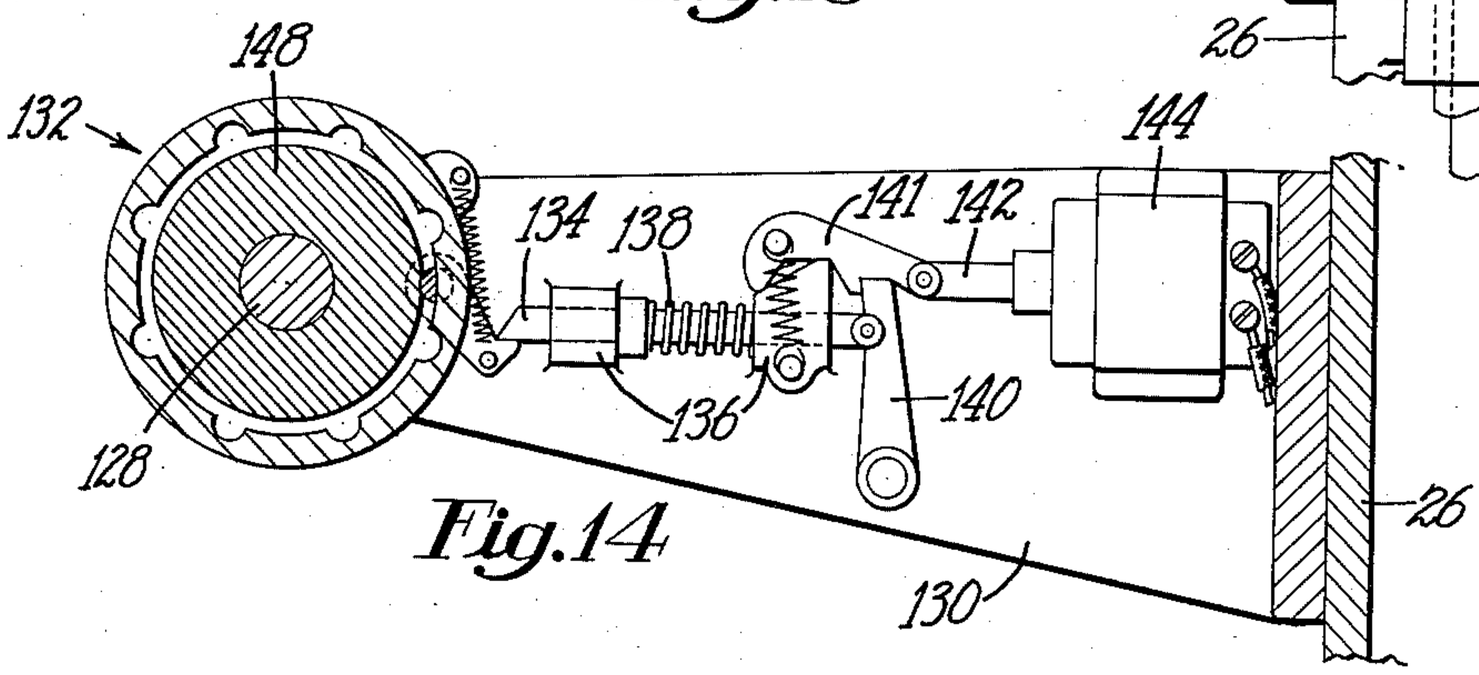
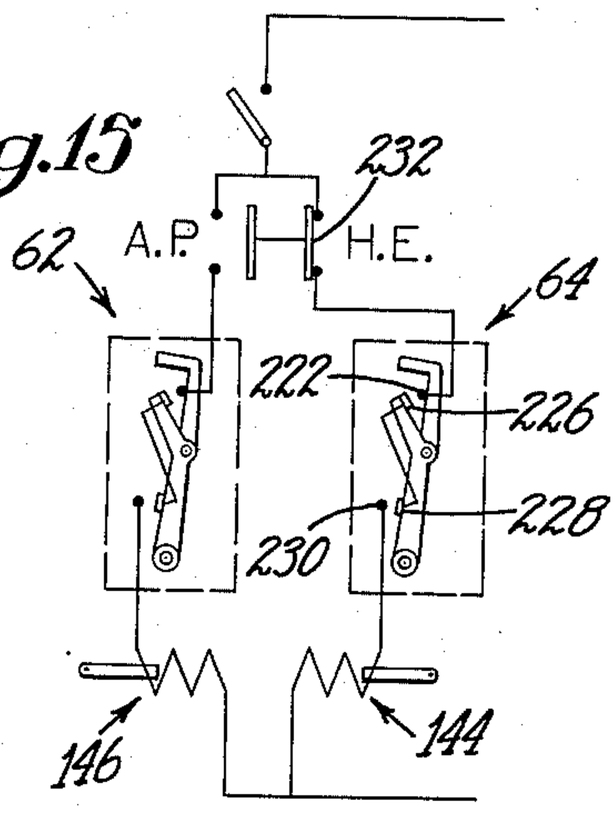


Fig. 14

Fig. 15



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United States Patent Office

3,101,647

Patented Aug. 27, 1963

3,101,647
AMMUNITION HANDLING APPARATUS

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Filed Apr. 4, 1952, Ser. No. 280,524
14 Claims. (Cl. 89—46)

This invention relates to ammunition handling apparatus and is illustrated herein as embodied in a magazine and a hoist for supplying ammunition automatically to a rammer of the type disclosed in an application of Charles J. Gross, Serial No. 280,498, filed on April 4, 1952.

The above-mentioned rammer is adapted for use with a gun of the type disclosed in an application of A.D. Willhauck, Serial No. 280,468, filed on April 4, 1952, now Patent No. 2,779,242, and is arranged to carry a shell from one side of the gun into alinement therewith, to project the shell into the gun chamber, which causes the gun automatically to be fired, and then to return to its original position in readiness to receive the next shell to be fired.

As is usual in gun installations aboard a ship, the above-mentioned gun and rammer, together with the ammunition handling apparatus disclosed herein, are arranged as a unitary structure capable of being installed upon or removed from the ship in one assembly. Moreover, in this kind of installation, the ammunition is stored a considerable distance from the gun in a magazine below the deck, and is carried from the magazine to the vicinity of the gun by a hoist. The magazine and hoist each comprise a conveyor, the magazine conveyor having a capacity sufficient to permit a burst of continuous rapid firing of considerable length before reloading of the magazine is required.

It is an object of the invention to provide an improved ammunition handling apparatus, including cooperating magazine and hoist conveyors, for supplying shells of either of two kinds, as selected by the gunner, with a frequency equal to or greater than that of the firing cycle of the gun, so that the rate of fire of the gun will not be limited by the supply of ammunition.

To this end, and in accordance with one feature of this invention, the illustrated apparatus includes, with a magazine having two compartments, one for each of two different kinds of ammunition, a conveyor for each compartment, mechanism for transferring the leading shell on either magazine conveyor to a hoist conveyor, and with driving means for each magazine conveyor, control means, arranged to be operated in synchronism with the hoist conveyor, for actuating both the driving means for the selected magazine conveyor and the mechanism for transferring the shell from this magazine conveyor to the hoist conveyor. Thus, in the usual operation in the illustrative apparatus, for every shell which is delivered from the hoist to the rammer, another shell is delivered from the magazine to the hoist at the end of each operating cycle of the hoist.

In each compartment of the magazine, the transfer of shells from the magazine conveyor to the hoist conveyor takes place at a loading station to which a series of shell holders on the hoist conveyor are brought, one at a time, during each operation of the hoist. The above-mentioned control means is operated, in accordance with a further feature of the invention, by and at the end of each operation of the hoist conveyor, to bring a sensing device into the shell receiving space associated with that holder which is moved to the loading station. From one standpoint, this control means is constructed and arranged to operate in response to the engagement of a sensing device with a shell in an already loaded holder to prevent another shell from being delivered to this holder. From

another standpoint, the control means is so arranged that, upon the movement of a sensing device into the shell receiving space of an empty holder, the driving mechanism for that magazine conveyor holding the type of ammunition selected by the gunner is actuated to cause the leading shell on that conveyor to be delivered to the hoist conveyor.

In accordance with a further feature of the invention, each shell holder upon the hoist conveyor comprises grippers which are closed against a shell by means of a spring loaded toggle connecting the grippers, the grippers also being constructed and arranged to sustain the weight of the shell during its delivery onto the holder by engagement with a shoulder on the shell. In order to facilitate the delivery of the shell to a holder, novel means is provided, at the loading station for separating the grippers, this means being operated in response to the engagement of the shell therewith as it is moved by the above-mentioned transferring mechanism from the magazine conveyor onto the hoist conveyor. This means, as illustrated herein, comprises a gate arranged to swing out of the path of the shell as it is moved past the gate, and which later, after the shell has been moved into the holder, swings back into its original position thereby permitting the grippers to close against the shell.

Invention is also to be recognized in improved means for delivering the shells from the hoist conveyor to the rammer at one side thereof, without requiring any other power than that derived from the momentum of the shell which is imparted to it by the conveyor, this means including provision for releasing the shell from the conveyor, as well as for depositing the shell upon the rammer with a movement which is transverse to the direction of the movement imparted to the shell by the conveyor.

These and other features of the invention will now be described in greater detail with reference to the accompanying drawings, showing an illustrative embodiment thereof, and will be defined in the claims.

In the drawings,

FIG. 1 is a side elevation of a gun turret, including the ammunition handling apparatus provided by the invention in its operative relation with respect to a rammer and a gun, the turret and its mount being shown in section;

FIG. 2 is a plan view of the gun, the rammer, and that part of the hoist which is above the base of the turret;

FIG. 3 is a plan view of the magazine as viewed from the level of the deck on which the turret is mounted, the loading station of the upper compartment of the magazine being shown in section;

FIG. 4 is an enlarged plan view of a part of the magazine, including the upper loading station, shown in FIG. 3;

FIG. 5 is a sectional side elevation of a part of the magazine, the section being taken along the line V—V in FIG. 4;

FIG. 6 is a sectional rear elevation of a part of the magazine, the section being taken along the line VI—VI in FIG. 4;

FIG. 7 is a sectional side elevation of a part of the magazine, the section being taken along the line VII—VII in FIG. 4;

FIG. 8 is a sectional side elevation showing the loading station of the lower compartment of the magazine, the section being indicated by the line VIII—VIII in FIG. 4;

FIG. 9 is a sectional side elevation of the upper portion of the hoist;

FIG. 10 is a sectional view of the upper part of the hoist illustrating a shell in a holder on the hoist just be-

fore the shell is released from the holder, the section being taken along the line X—X in FIG. 9;

FIG. 11 is a sectional view similar to FIG. 10, and illustrating the release of the shell from the shell holders;

FIG. 12 is a sectional plan view illustrating the relation of the transfer tray to the rammer when the transfer of the shell from the hoist to the rammer begins, the section being taken along the line XII—XII in FIG. 9;

FIG. 13 is a side elevation of a portion of the driving mechanism for the magazine conveyors;

FIG. 14 is a sectional elevation of the mechanism shown in FIG. 13, the section being taken along the line XIV—XIV; and

FIG. 15 is a diagram of electrical connections employed in the mechanism for controlling the operation of the magazine conveyors.

For convenience of illustration and description, only the right-hand gun **10** (FIG. 1) of a dual mount, together with the associated rammer **12**, and ammunition handling apparatus comprising a hoist **14** and magazine **16**, are shown in the drawings and will be described below.

The gun and rammer are mounted upon trunnions for movement together in elevation between a pair of pedestals **18** which are fixed to the deck **20** of a turret, the latter being mounted to rotate in train upon a bearing circle **22** which is fixed to the ship's deck **24**.

The hoist comprises a housing **26** which is fixed to the turret deck **20** and extends downwardly through the deck from the level of the gun to the magazine **16**. In the upper part of the housing there is mounted a shaft **28** carrying a double sprocket **30** (FIGS. 9 and 10) about which a pair of chains **32, 32**, constituting a part of the hoist conveyor, is looped, each chain being guide in a T-shaped guideway **34** formed in the housing **26**, and by idler sprockets **36, 38** the former being disposed just below the shaft **28**, and the latter being rotatably mounted near the base of the lower compartment **40** of the magazine (FIG. 8). A similar idler sprocket **39** having the same function as that of the sprocket **38** is mounted in the lower part of the upper compartment **42** of the magazine. The hoist conveyor is thus arranged to run vertically through the magazine, this arrangement permitting the storage of different kinds of shells, such as armor piercing shells and high explosive shells, each in its own compartment, and allowing either kind of shell, as selected by the operator, to be loaded upon the hoist conveyor.

This conveyor carries a series of shell holders each comprising a pair of grippers **44, 44** (FIGS. 8, 10 and 11) arranged to engage the shell case near its flanged end, and a smaller pair of grippers **46, 46** arranged to engage the projectile. Each time when the rammer **12** moves to its shell receiving position (FIGS. 2 and 12) a switch **48** is closed which causes a solenoid operated plunger **50** (FIG. 9) to trip a one-revolution rolling-pin type of clutch **52**. The hoist conveyor is now operated through one cycle, and discharges the leading shell thereon into a chute **54** which hinges upon the shaft **28** with the gun as it is moved in elevation. The chute directs the shell onto a transfer tray **56** which is mounted to swing parallel to itself, under the momentum of the shell, first longitudinally thereof, and finally laterally thereof, to deposit the shell upon the above-mentioned rammer **12**. While this action takes place at the upper end of the hoist conveyor, the lowest shell holder on the descending run of the conveyor is moved to a loading station in the lower magazine compartment, and the shell holder last occupying the loading station of the lower magazine compartment is advanced to a loading station in the upper compartment.

Each compartment of the magazine has a conveyor comprising a pair of upper and lower endless chains **58, 58** (FIGS. 5, 6 and 7) of sufficient length to accommodate about 80 shells, and one conveyor or the other is operated intermittently to bring the shells, one at a time, to the

loading stations. At each loading station there is a transferring mechanism, including a pair of cam members **60, 60** (FIG. 8), which propel the shell last advanced thereto from the magazine onto the holder on the hoist conveyor which is at the loading station, if that holder is empty, and if the gunner has selected for firing the type of shell which is in the magazine compartment to which the empty holder has been brought. Thus, at the end of each cycle of operation of the hoist conveyor one or the other of the magazine conveyors, according to the type of shell to be supplied to the hoist conveyor, is operated by its driving mechanism under the control of identical upper and lower sensing devices **62, 64** (FIGS. 8 and 4) which are mounted to swing into the shell receivng spaces of the shell holders at the loading stations, at the end of each cycle of operation of the hoist conveyor. If, during this movement, either sensing device engages a shell on the hoist conveyor it prevents the corresponding magazine conveyor from supplying another shell to the already loaded holder on the hoist conveyor; but if a sensing device is moved into the shell receiving space of an empty shell holder, the associated magazine conveyor, if it holds the type of ammunition selected by the gunner, is operated to replenish that holder as will be described in detail below. In this connection, it is evident that at the end of each cycle of operation of the hoist conveyor an empty shell holder will always be brought to the loading station of the lower magazine compartment. However, if the gunner, after having fired shells from the lower compartment, desires to fire the different type in the upper compartment, the conveyor and transfer mechanism in the upper compartment of the magazine will not be operated until the holders on the hoist conveyor which have been loaded in the lower magazine have passed beyond the loading station of the upper compartment.

Having broadly outlined the principal features and mode of operation of the illustrated apparatus, it will be further described below in detail.

Each of the magazines, which are of identical construction, comprises sets of web-frames **66** at its top and bottom, each set of frames being bolted together in the arrangement shown in FIG. 3, and the upper and lower frames being held in the proper spaced relation by a series of struts **68** (FIG. 1). T-slots **70** (FIG. 6) formed in bars **72** which are integral with the web-frames constitute guideways for the above-mentioned chains **58, 58**. Upon the right-hand ends of successive pairs of web-frames there are fixed end-frames **74** (FIG. 3) in each of which there is rotatably mounted a shaft **76** carrying upper and lower sprockets **78, 78** around which the chains travel from one set of web-frames to the next Secured to the left-hand ends of the forward web-frames is an offset end-frame **80**, having T-slots formed therein in continuation with the above-mentioned T-slots **70**, and provided with pairs of idler sprockets **82, 84**, over which the chains **58** are directed so as to avoid interference with the hoist housing **26**. The rear portion of the end frame **80** is fixed to the left-hand ends of the rearmost web frames **66**, and is also provided with T-slots in continuation of the above-mentioned T-slots **70**. Another pair of idler sprockets **86**, rotatably mounted upon the rear portion of the end frame, directs the chains through the angle between the straight runs of the chains at each side of these sprockets. At the left-hand end of the end-frame **80** of each compartment there is rotatably mounted a drive shaft **87** which carries a pair of sprockets **88** about which the chains **58** run. Hinged upon the left-hand end of each end-frame **80** is a door **89** (FIG. 4) which may be opened to permit ammunition to be loaded upon the conveyor. The flanged ends of the shells are guided throughout the sinuous path of the chains **58, 58** between lips **90** (FIG. 6) which extend downwardly from the upper web-frame **66**, these lips being grooved at **92** to receive the flanges on the shells, thus to support the

weight of the shells. The projectile of the shell runs between guides 94 which are fixed to the struts 68 connecting the upper and lower web-frames. Connecting the upper and lower chains 58, 58 is a series of rods 96, each rod carrying a set of spacers 98, of different sizes corresponding to the different diameters of the parts of the shell engaged by the spacers, the rods and spacers being so proportioned and located as to receive the shells with only a slight clearance, and to hold them in a vertical position through their travel in the magazine.

To load the magazine, shells are inserted through the open door 89 and placed between successive groups of spacers 98, the chains being driven manually with a step-by-step retrograde movement until the first shell loaded into the magazine has reached the inner end thereof at 100 (FIGS. 3 and 4) at which time about 80 shells will have been loaded into the magazine. After this operation has been completed, the door is closed, and thereafter is utilized during the advancing movements of the magazine conveyor to direct the shells therefrom toward the loading station, from which they are eventually transferred to the hoist conveyor. The advancing shells, upon reaching the sprockets 88, continue to be supported by their flanges, which rest upon the top edge of the door 89 and a shoulder 101 fixed to the end-frame 80. Another shoulder 102 cooperates with the shoulder 101 to support and direct the shells in their movement off the door 89 and magazine conveyor, and into the loading station. The conveyor chains 58, 58 are intermittently operated, to deliver the shells to the loading station, as a result of a step-by-step movement of the drive shaft 87 which is operated by the following mechanism.

To the upper and lower ends of the shaft 87 in the upper compartment are fixed gears 103, 103 (FIG. 1), a similar pair of gears 104, 104 also being fixed to the ends of the lower shaft 87. These gears are driven by pairs of pinions 105, 106 (FIG. 8), respectively, the former pinions being fixed to a tube 107 which extends through and above the upper magazine compartment. The latter pinions are fixed to a shaft 108 which is rotatably mounted within the tube and extends from the base of the lower magazine compartment to a point just below the deck 24. Upon the upper ends of the shaft 108 and tube 107 there are fixed sprockets 116, 118 (FIG. 13), respectively, which are connected by chains 120, 122 to another pair of sprockets 124, 126, the latter being mounted to rotate upon a shaft 128 (FIG. 14) which is mounted upon a bracket 130 fixed to the hoist housing 26. Associated with the sprocket 124 is a rolling-pin type of one-revolution clutch 132, of usual construction, which is normally held in a disengaged state by a plunger 134. This plunger is mounted to slide horizontally in bearings 136, which are integral with the bracket 130, and is yieldingly held in its operative position by a spring 138. The end of the plunger remote from the clutch is connected to a lever 140, hinged at its lower end upon the bracket 130, and adapted to be engaged at its upper end by a hook 141 which is connected to the plunger 142 of a solenoid 144. When the solenoid is energized, the plunger 134 is retracted permitting the clutch 132 to become engaged. During the latter part of the movement of the plunger 142 the hook 141, which overlies an incline formed on the upper side of one of the bearings 136, is lifted out of engagement with the lever 140, whereby the plunger 134 is permitted to return to its operative position in readiness to disengage the clutch upon the completion of one revolution thereof. The plunger 134 cannot be actuated again to trip the clutch until the solenoid has been deenergized, and the hook 141 has reengaged the lever 140. An exactly similar mechanism, operated by another solenoid 146, is provided for operating the other sprocket 126. A driving element 148, common to both clutches and rotatably mounted upon the shaft 128, is fixed to a flywheel 150 which is connected by belts 152 to a motor 154 (FIG. 1), the latter being mounted upon

a beam 156 by which the magazine is suspended from the turret deck 20.

One or the other of the solenoids 144, 146 is actuated, as will be explained later, to cause a shell in the magazine to be transferred to the hoist conveyor as soon as it comes to rest at the end of each cycle of its operation.

As stated above, each shell holder of the hoist conveyor comprises a pair of grippers 44, 44 (FIG. 8) and a smaller pair of grippers 46, 46, these pairs of grippers being so spaced along the chains 32, 32 that the larger grippers engage the shell near its flanged end, while the smaller grippers engage the projectile of the shell. Each pair of grippers is pivotally mounted upon a U-shaped yoke 158 (FIGS. 4, 8 and 10) which is carried by the chains 32, 32. The inner ends of each pair of grippers are connected by toggle links 160, 160 which are urged toward their extended relation by a spring 162 so as to cause the forward ends of the grippers to close against a shell which is seated in the yokes.

At the end of each cycle of operation of the hoist conveyor, a shell holder is brought to the loading station in each magazine compartment. That is, the grippers 44, 46 will be brought into the relation with respect to the leading shell supported by the shoulders 101, 102 at the loading station, illustrated in FIG. 8. During each cycle of operation of the magazine conveyor a shell, such as that at 164 (FIG. 4), is guided by the door 89 between the shoulders 101, 102 under the camming action of the spacers 98, which run off the shell at its left-hand side as they pass the loading station. Each shell is thus pushed into the field of action of the cam members 60, there being a pair of such members at the loading station in each magazine compartment. These members in the lower compartment are fixed to the shaft 108, while the similar members in the upper compartment are fixed to the tube 107. These members are, therefore, driven, in synchronism with the chains 58, through one revolution for each cycle of operation of the chains. During each revolution of the cam members, hollow shoulders 168 thereon engage the shell which has just left the magazine conveyor, and drive it along the shoulders 101, 102 into the empty shell holder on the hoist conveyor at the loading station. During the latter part of this movement, and as the shell approaches the ends of the shoulders it passes between a pair of upper gates 170 and another pair of lower gates 171 which are mounted to swing about vertical axes upon the end-frame 80, in response to the advancing movement of the shell. As these gates are separated they cooperate with the outer ends of the grippers 44, 46 to move the latter to their open positions so that the shell is freely admitted into the shell holder. Before the flange of the shell moves off the shoulders 101, 102, a shoulder on the projectile at 172 becomes seated upon the lower grippers whereby the weight of the shell is sustained when the shoulders 101, 102 no longer support the shell, and until the shell becomes seated upon the holder with its shoulder at 172 overlying the lower yoke 158. As the shell passes through the gates, they are moved toward their closed positions by springs 173 (FIG. 4), and in doing so release the grippers so that the latter may close behind the shell.

When during each cycle of operation of the hoist conveyor, the leading shell thereon passes into the chute 54 (FIGS. 9, 10 and 11), the inner ends of the grippers 44, 46 engage the inner converging sides of the sprocket 30, causing the toggles 160 to be collapsed, the grippers to be opened, and the shell to be released from the shell holder. The shell, under the momentum imparted to it by the hoist conveyor, now passes through the chute, which is shaped and arranged so as to direct the shell into the above-mentioned transfer tray 56. This tray has a shoulder 176 (FIG. 12) at its rear end against which the flanged end of the shell becomes seated, and through which the momentum of the shell is transmitted to the tray. The tray is mounted for parallel swinging movement upon a pair of U-shaped arms 178, 180 (FIGS. 9 and 12) which

connect the forward and rear ends of the tray, respectively, with the chute **54**. It will now be evident that, as soon as the shell strikes the shoulder **176**, the transfer tray will be swung, first rearwardly and finally laterally of the shell, by momentum of the shell, until the tray reaches its broken line position in FIG. 12. At this time, the shell is deposited upon the above-mentioned Gross rammer, and the transfer tray is immediately returned to its original position by springs **190, 190**, which are stretched between the chute **54** and the arm **180**. The return movement of the transfer tray is snubbed by a buffer plunger **192** which is yieldingly mounted upon the chute **54**. The shell is guided at its forward end in its movement into the rammer, between a pair of arcuate converging guides **194** which are formed integral with the chute, and a similar pair of parallel guides **198** support the flanged end of the shell throughout this movement.

Near the end of the swinging movement of the transfer tray toward the rammer, angular extensions **199, 200** on the outer ends of arms **178, 180**, respectively, engage the outer side of the shell and locate it with respect to the transfer tray so that the shell will be firmly seated upon the rammer. The extensions **199, 200** are moved through openings **201, 202**, respectively, in the outer side of the transfer tray as a result of the changing angular relation relation between the arms **178, 180** and the transfer tray, this arrangement also insuring that the extensions will have been moved out of the path of the next shell to be supplied to the transfer tray when the latter has been returned to its original position in alinement with the chute **54**.

As may be more clearly understood from the Gross application, the shell, upon being deposited upon the rammer, is held there, so that it cannot follow the transfer tray during its return movement, by hinged holders **203** which open as the shell is inserted into the rammer, and are then closed against the outer side of the shell. Similarly, the forward end of the shell is locked in the rammer by a pair of pawls, not disclosed herein, but fully shown and described in the Gross application.

Each time when the rammer moves into its shell receiving position, as illustrated in FIG. 12, the above-mentioned switch **48** is closed, completing the circuit to the solenoid which operates the plunger **50** (FIG. 9) for tripping the above-mentioned clutch **52**. The operation of the hoist conveyor through one cycle is thus started, and the leading shell thereon is projected into the chute **54**, and thence into the transfer tray which deposits the shell upon the rammer, as described above. The clutch **52** engages the sprocket **30** with a flywheel **204** (FIG. 1) which is mounted to rotate upon the shaft **28** and is connected by belts **206** to a motor **208**, the latter being fixed to the turret deck **20**. Solenoid operated mechanism similar to that used in connection with the above-described clutch **132** in the driving mechanism for the magazine conveyors is provided for tripping the clutch **52** and, once operated, is not reset, so that it can again trip the clutch, until the switch **48** is opened again, that is, when the rammer is moved out of its shell receiving position to deliver the shell driven therein to the gun. Accordingly, once the hoist conveyor has been operated to load the rammer, this conveyor cannot again be operated until the rammer has gone through a cycle of its operation and has returned, empty, to its shell receiving position.

Other control mechanism, including the above-mentioned sensing devices **62, 64** operable in timed relation to the hoist conveyor, is provided for operating one or the other of the magazine conveyors, according to the desire of the gunner as to the type of ammunition to be supplied to the hoist. It is to be understood that the sensing devices are identical in construction, and that they will be described below with reference to the showing of the upper device in plan in FIG. 4, and of the lower device in side elevation in FIG. 8. Each of these devices comprises upper and lower arms **210** and **212** which are fixed upon the opposite ends of a shaft **214**

which is rotatably mounted on the inner side of the hoist housing **26**. The lower arm carries a cam roll **216** arranged to run upon a cam **218** which is effectually integral with the sprocket **38**, a similar cam also being associated with the sprocket **39**. Upon the upper arm **210** there is pivoted a feeler **220** carrying an electrical contactor **222** which, when the arm **220** is swung in a counterclockwise direction, under the influence of a spring **224** stretched between the feeler and the arm **210**, engages another contactor **226** on the upper end of the arm **210**. Electrically connected with the contactor **226** is another contactor **228** which is pivotally mounted for limited yielding movement upon the hub of the arm **210**. The shape of the cam **218** is such as to cause the arm **210** to swing from a clear space between the runs of the hoist conveyor into the shell receiving space of that shell holder which is moved to the loading station at the end of a cycle of operation of the hoist conveyor. If that shell holder is empty, the contactors **222** and **226** remain in engagement with each other, and the contactor **228** will be moved into engagement with another contactor **230** which is fixed to an arm **231** mounted upon the hoist housing. When both sets of these contactors on the lower sensing device **64** are closed, an electrical circuit is completed to the solenoid **144** (FIG. 15), assuming that the gunner has closed a selector switch **232** at the firing station corresponding to the type of ammunition with which the lower magazine compartment has been loaded. Under these circumstances, a shell will be delivered by the lower magazine conveyor and transfer mechanism into the shell holder at the lower loading station (FIG. 8), and during the latter part of this movement of the shell it engages the feeler **220**, and swings it counterclockwise upon the arm **210**, whereby the contactors **222** and **226** are separated and the circuit to the solenoid **144** is opened.

If, as may occur at the upper loading station a shell holder, already loaded from the lower magazine compartment, moves to the loading station of the upper compartment and the upper sensing device **62** moves toward the shell receiving space of this holder, the feeler **220** upon engaging the shell will be swung clockwise upon the arm **210** causing the contactors **222** and **226** to be separated before the contactors **228, 230** engage each other. Accordingly, the circuit to the solenoid **146** for actuating the upper magazine conveyor cannot be closed even though the operator has operated the selector switch **232** calling for the type of ammunition contained in the upper magazine compartment. Thus, when it is desired to change from the type of ammunition in the lower compartment to that in the upper compartment, the hoist conveyor will be operated through two cycles of its operation before the desired ammunition is supplied to it. On the other hand if, after having used the type of ammunition in the upper magazine compartment, it is desired to change to that of the lower compartment, ammunition from that compartment will be loaded upon the hoist conveyor at the end of the first operation of the hoist conveyor after the decision to change ammunition has been made, since an empty shell holder is always brought to the loading station of the lower magazine compartment during every cycle of operation of the hoist conveyor.

The operation of the apparatus disclosed herein will now be briefly summarized. Upon the return of the rammer **12** to its shell-receiving position the switch **48** is closed, causing the engagement of the clutch **52** which drives the hoist **14** through one cycle of operation. When the grippers **44, 46**, holding the foremost shell on the hoist, pass over the sprocket **30** they are opened, freeing the shell for movement under its own momentum through the chute **54** and onto the transfer tray **56**. The tray, motivated by the momentum of the shell, now swings on the arms **178, 180** first rearwardly, and then laterally of the gun **10**, to deposit the shell on the rammer. During this movement of the shell it is guided by the arcuate

guides 194, 198; and the extensions 199, 200 on the arms 178, 180 insure the proper seating of the shell upon the rammer. Having thus delivered the shell to the rammer, the transfer tray immediately returns to its shell-receiving position under the influence of the springs 190.

The above-described operation of the hoist, transfer tray and rammer will now be repeated immediately if the gunner holds the firing switch closed, as when it is desired to fire in a continuous burst.

Toward the end of each operation of the hoist, and in response thereto, the sensing devices 62, 64 are swung toward the hoist at the loading stations; and if the shell holder at that loading station corresponding to the type of ammunition for which the selector switch 232 has been set is empty, a shell will be supplied to that holder from the appropriate magazine conveyor. A cycle of operation of this conveyor is initiated by the closing of the contactors 222, 226 and 228, 230 and the engagement of one of the clutches 132, each cycle of operation being terminated automatically by the disengagement of the clutch at the end of a full revolution thereof.

During each advancing movement of the magazine conveyor the leading shell thereon is directed into the loading station between the shoulders 101, 102 which support the shell by its flange. The shell is propelled by the cam member 60 between the gates 170, 171 which, in being separated by the shell, open the grippers 44, 46 to receive the shell. The gates upon closing behind the shell release the grippers which are closed around the shell by the spring-loaded toggle links 160.

The operating cycle of the magazine is timed so that it is completed before the arrival of the rammer in its shell-receiving position, in order avoid delaying the next cycle of operation of the hoist.

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

1. In an ammunition handling apparatus, the combination with a rammer movable between a shell receiving position and a ramming position, of a hoist conveyor having a series of spaced shell holders, driving means actuated by movement of said rammer into its shell receiving position for operating said hoist conveyor to deliver the leading shell thereon to the rammer and to bring an empty holder to a loading station, a magazine conveyor for delivering shells to said loading station, driving means for said magazine conveyor, transfer mechanism operable simultaneously with said magazine conveyor for delivering the shell thereon at the loading station to said hoist conveyor, and control means operable in timed relation to said hoist conveyor for actuating said magazine conveyor driving means, said control means being mounted for movement into the shell receiving space associated with that holder which is moved to the loading station at the end of the operation of said hoist conveyor.

2. Ammunition handling apparatus comprising a hoist conveyor having a series of shell holders thereon, means for operating said hoist conveyor to bring said holders successively to a loading station, a magazine conveyor movable intermittently to advance shells thereon one at a time to said station, mechanism operable simultaneously with said magazine conveyor for transferring the shell at said station from said magazine conveyor to said hoist conveyor, and controlling means operated by said first-mentioned means at the end of each movement of said hoist conveyor for actuating said magazine conveyor, said controlling means being mounted for movement into the shell receiving space of the holder at the loading station.

3. In an ammunition handling apparatus, the combination with a rammer mounted at one side of a gun, of a hoist operable to project shells therefrom rearwardly of the gun and at the side of the rammer remote from the gun, and a transfer tray for receiving the shells from the hoist, said tray being mounted to swing laterally of

the path of movement of the shell and driven by the momentum of the shell whereby the shell is discharged into the rammer in a direction extending crosswise of the gun.

4. In an ammunition handling apparatus, the combination with a rammer mounted at one side of a gun, of a transfer tray disposed at the side of the rammer remote from the gun, and a hoist by which shells are projected longitudinally thereof rearwardly of the gun into said transfer tray, said transfer tray being operable to discharge the shells laterally thereof into the rammer and driven by the momentum of the shells in their movement into said tray.

5. In an ammunition handling apparatus, the combination with a rammer mounted at one side of a gun, of a transfer tray, a hoist by which shells are projected rearwardly of the gun towards the tray, a chute for directing the shells from said hoist into said tray, and a pair of arms upon which said tray is mounted to swing parallel to itself under the momentum of the shell to deposit the shell on the rammer, said arms being movable into engagement with the shell toward the end of their swinging movement to position the shell on the rammer.

6. In an ammunition handling apparatus, the combination with a rammer mounted at one side of a gun, of a transfer tray, a hoist by which shells are projected rearwardly of the gun towards the tray, a chute for directing the shells into said tray, a pair of arms upon which said tray is mounted to swing with respect to said chute rearwardly thereof and toward the rammer in an arcuate path, and arcuate guideways upon said chute for directing the shell into the rammer, said arms being movable into engagement with the shell at the end of their swinging movement to position the shell in the rammer.

7. Ammunition handling apparatus comprising a hoist conveyor having a series of shell holders thereon, each of said holders comprising a pair of yielding grippers for holding a shell in said holder, a chute into which the shells are discharged from said conveyor, means including a sprocket for guiding said conveyor out of said chute, said sprocket cooperating with said grippers to release the shell as said conveyor passes said sprocket.

8. In an ammunition handling apparatus, the combination with a rammer mounted at one side of a gun, of a transfer tray disposed at the side of the rammer remote from the gun, a hoist by which shells are projected rearwardly of the gun toward said tray, a chute for directing the shells from the hoist into said tray, said tray being mounted upon said chute to swing under the influence of the shell first longitudinally thereof and then laterally thereof into register with the rammer whereby the shell is deposited under its own momentum upon the rammer, and means for returning said tray into alinement with said chute in readiness to receive the succeeding shell.

9. Ammunition handling apparatus comprising a hoist conveyor having a series of shell holders, each of said holders comprising a pair of grippers and a spring loaded toggle acting upon said grippers to cause them to close against a shell in the holder, a chute into which the shells are discharged from said conveyor, means for guiding said conveyor into said chute along a path extending longitudinally thereof and thence out of said chute transversely thereof, and means for collapsing said toggles as the grippers associated therewith pass into said chute whereby the shells are released from the grippers.

10. Ammunition handling apparatus comprising a hoist conveyor, a magazine conveyor for supplying shells in succession to said hoist conveyor, ways for supporting a shell during its passage from said magazine conveyor to said hoist conveyor, means operable in synchronism with said magazine conveyor for propelling the shell along said ways, shell holders on said hoist conveyor comprising grippers mounted for closing movement against a shell presented to said holders, and means actuated by move-

ment of the shell off said ways for opening said grippers.

11. An ammunition handling apparatus comprising a hoist conveyor, a magazine conveyor for supplying shells in succession to said hoist conveyor, means for transferring the leading shell in said magazine conveyor to said hoist conveyor, said means comprising ways for supporting the shell by engagement with its flange, and shell holders on said hoist conveyor, each holder comprising cooperating yielding grippers for holding a shell inserted therebetween, said grippers also cooperating with a shoulder on the shell positively to sustain the weight thereof when it passes off said ways.

12. Ammunition handling apparatus comprising a hoist conveyor, a magazine conveyor for supplying shells in succession to said hoist conveyor, ways for supporting a shell during its passage from said magazine conveyor to said hoist conveyor, shell holders on said hoist conveyor comprising grippers movable into and out of a closed position, means for urging said grippers toward their closed position, means operable in synchronism with said magazine conveyor for propelling the shell along said ways and into said holders, and a gate cooperating with said grippers to separate them in response to movement of the shell past the gate and to release them for movement into their closed position when the shell has become seated in said holders.

13. Ammunition handling apparatus comprising a hoist conveyor, a magazine conveyor for supplying shells in succession to said hoist conveyor, ways for supporting a shell during its passage from said magazine conveyor to said hoist conveyor, means operable in synchronism with said magazine conveyor for propelling the shell along said

ways, shell holders on said hoist conveyor comprising separable grippers mounted for movement between an open and a closed position, means for yieldingly holding said grippers in closed position, and a gate mounted at each side of the path of the shell, said gates being mounted to swing away from each other upon movement of the shell therebetween, said gates also being operable successively to open and release said grippers during movement of the shell from between the gates into said holders.

14. Ammunition handling apparatus comprising a hoist conveyor, a magazine conveyor for supplying shells in succession to said hoist conveyor, ways for supporting a shell during its passage from said magazine conveyor to said hoist conveyor, means operable in synchronism with said magazine conveyor for propelling the shell along said ways, shell holders on said hoist conveyor comprising grippers mounted for closing movement against a shell presented to said holders, and a pair of gates between which the shell passes in its movement into said holders, said grippers cooperating with a shoulder on the shell to support it, said gates also being mounted to separate when the shell passes between them and to cooperate with said grippers to separate and release the latter during the movement of the shell through the gates.

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