Oct. 13, 1953 H. W. ALDRIN ET AL 2,655,079

LOADING MECHANISM FOR GUNS

Filed Oct. 18, 1949 3 Sheets-Sheet 1

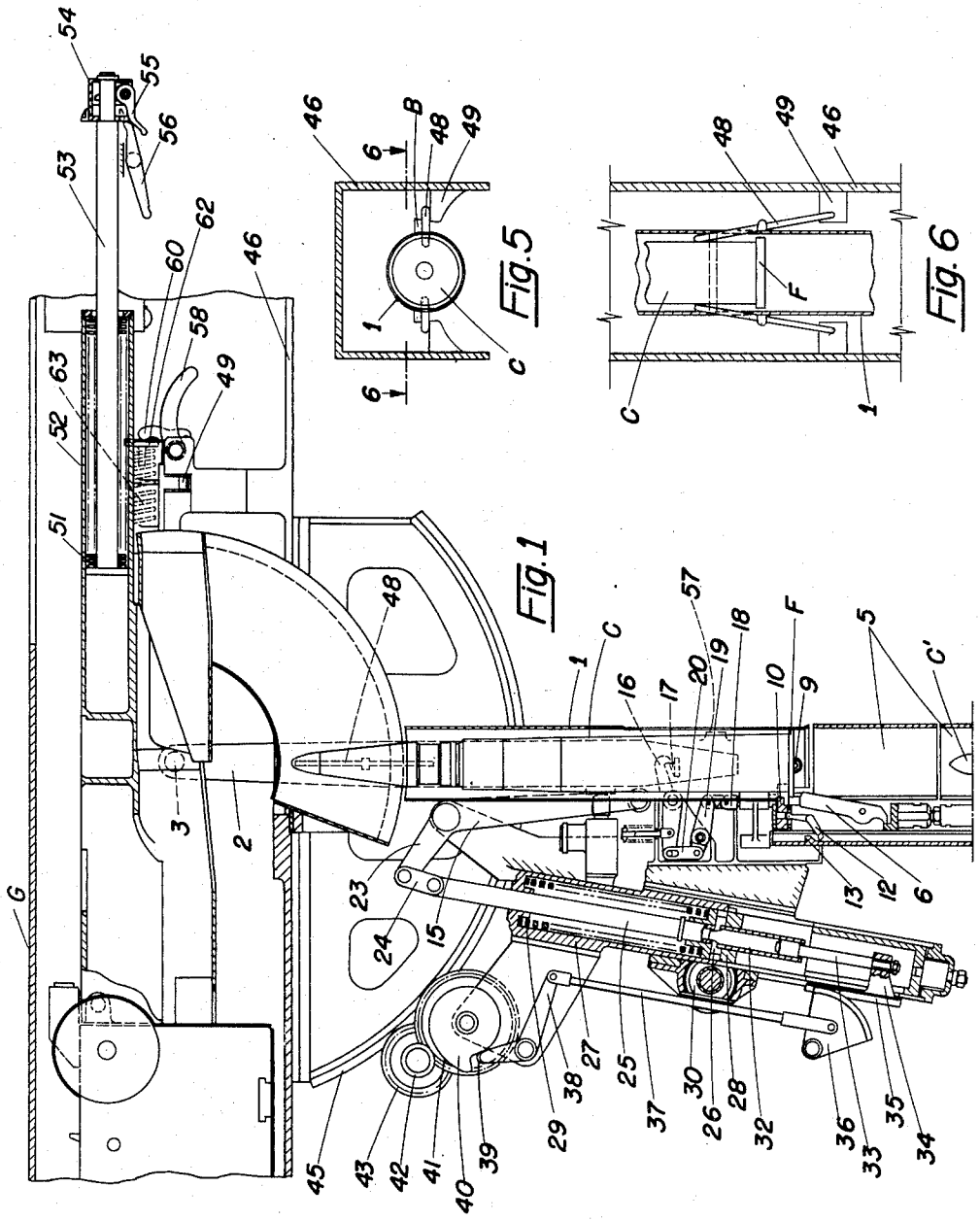

Fig. 1

Fig. 5

Fig. 6

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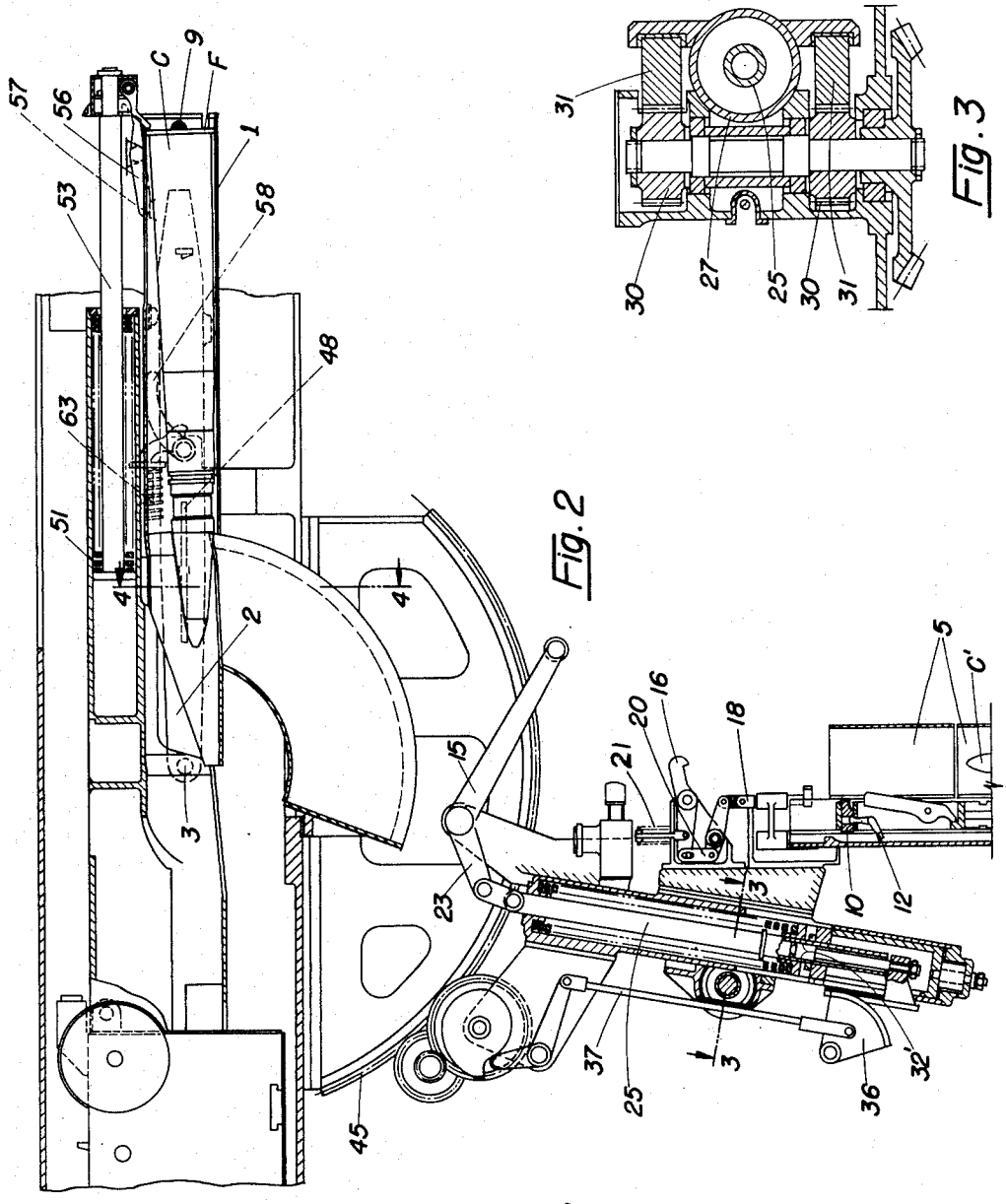

Fig. 2

Fig. 3

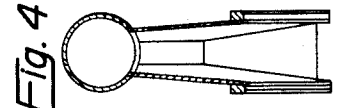

Fig. 4

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LOADING MECHANISM FOR GUNS

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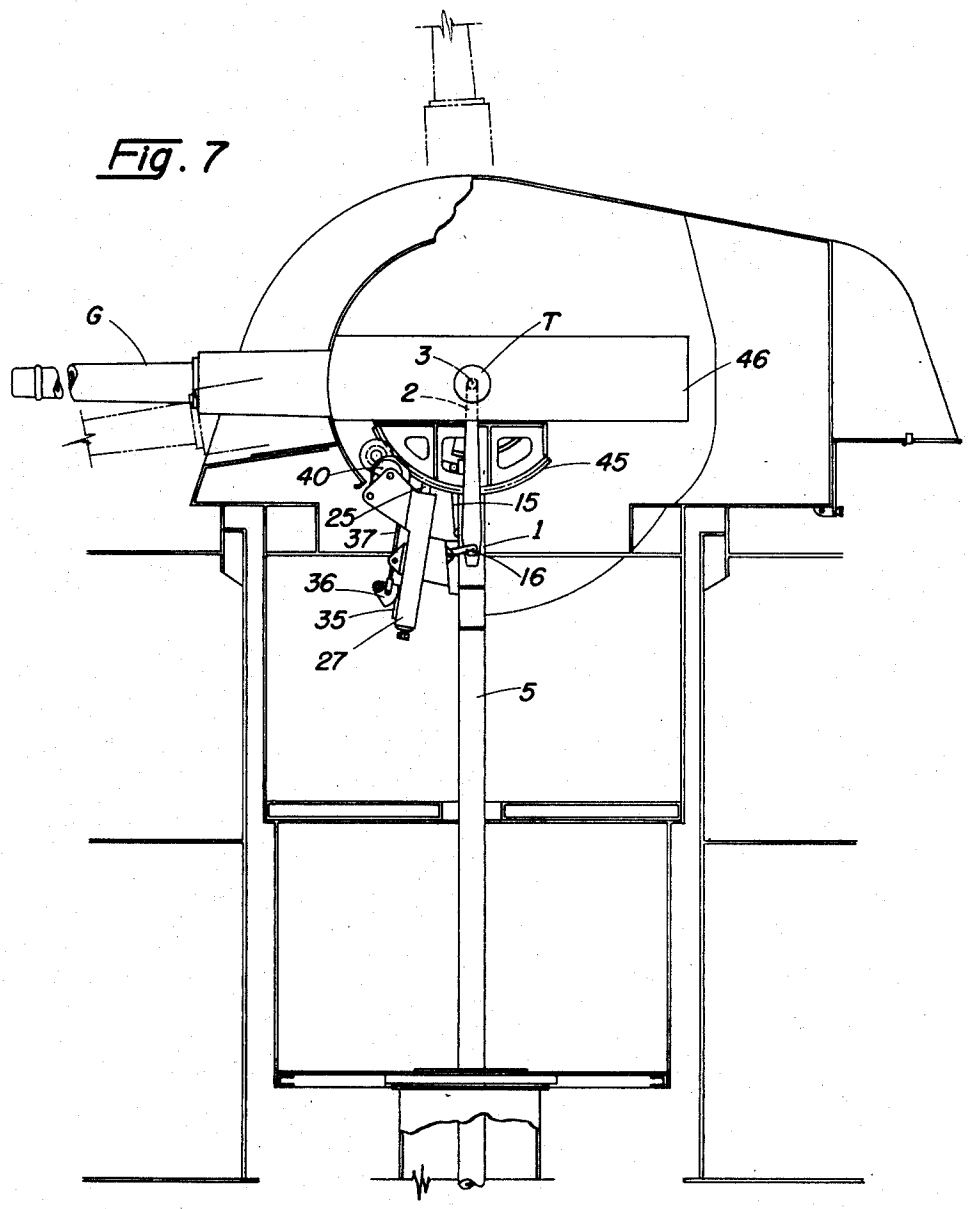
Fig. 7



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2,655,079

LOADING MECHANISM FOR GUNS

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14 Claims. (Cl. 89—45)

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This invention relates to loading mechanism for guns and is particularly directed to means for rapidly loading projectiles from an ammunition hoist or the like successively into a gun at any elevation of the latter to facilitate promotion of a high rate of fire.

So called "medium" and "heavy" guns, particularly those mounted in movable turrets as on board naval vessels, are customarily provided with auxiliary mechanism including for each gun an ammunition hoist adapted to deliver projectiles from a subjacent magazine or other compartment to the vicinity of the gun; to transfer the projectile from the hoist to the gun breech it therefore must be moved from the hoist, in which its longitudinal axis is substantially vertical, and brought to a position for ramming into the gun and thus in alignment with its bore, which may be at substantially any angle from nearly vertical to horizontal or even below horizontal depending on the elevation required to train the gun on its target.

Modern guns of the character to which the invention relates are usually supplied with ammunition in the form of cartridges comprising both the projectile and the propellent charge and as automatic devices have been developed for ramming and firing the gun and thereafter ejecting the empty cartridge case in a very short period of time, the rapidity with which successive rounds can be fired is determined to a large extent by the speed of transfer of the cartridges from the ammunition hoist to the ramming mechanism. In many instances this transfer is effected manually by the gun crew although mechanisms have been proposed for accomplishing it automatically and when properly operating give the gun a comparatively high rate of fire. But these mechanisms are extremely complicated, expensive to construct and maintain and difficult to restore to effective operative condition when damaged.

In accordance with the present invention however, automatic gun loading mechanism is provided which include a tubular loading tray supported from arms pivoted coaxially with the gun trunnions and adapted to swing between a position aligned with the ammunition hoist and one aligned with the gun breech, together with locking elements at the limit of its travel for holding it in each of said positions for appropriate periods during the cycle of operations and means for imparting to the tray at either of such positions sufficient impetus to carry it to the other whether it be supporting a cartridge to

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be loaded into the gun or is being returned after the loading to position for receiving the succeeding one from the ammunition hoist, the tray swinging freely to the respective limit positions after having had the requisite impetus imparted to it adjacent the other.

It is therefore a principal object of the invention to provide mechanism which is substantially automatic in operation and operative to convey cartridges successively and with great rapidity from an ammunition hoist into alignment with the axis of the gun breech and thus in position to be acted upon by the ramming mechanism.

A further object is to provide mechanism of this character operative at any elevation of the gun barrel and which therefore permits the gun to be set at a desired elevation for the firing of a plurality of rounds and a corresponding number of cartridges fed successively to it for firing without changing that elevation.

Other objects, purposes and advantages of the invention will hereafter more fully appear or will be understood from the following description of one embodiment of it illustrated in the accompanying drawings in operative association with a gun and ammunition hoist therefor of which only as much is illustrated as is required for adequate comprehension of the invention.

In the said drawings Fig. 1 is a diagrammatic vertical section of the gun loading mechanism showing the cartridge loading tray in a position aligned with the ammunition hoist after having received a cartridge therefrom preparatory to transferring it to ramming position.

Fig. 2 is a corresponding section showing the loading tray supporting the cartridge in alignment with the gun barrel adjacent the ramming mechanism preparatory to ramming.

Fig. 3 is a transverse section on the line 3—3 in Fig. 2 showing certain details of the loading tray actuating mechanism illustrated in the preceding figures.

Fig. 4 is a fragmentary section on the line 4—4 in Fig. 2.

Fig. 5 is a fragmentary section through the recoil jacket of the gun, and

Fig. 6 is a fragmentary horizontal section on the line 6—6 in Fig. 5.

Fig. 7 on a smaller scale is a fragmentary largely diagrammatic side elevation, partly in vertical section, showing a naval gun turret containing the gun and hoist with the said gun loading mechanism in operative relation thereto but with certain usual auxiliary apparatus omitted.

Referring now more particularly to the drawings, the gun, generally designated G, is mounted for elevational motion about a horizontal axis on trunnions T in the customary way and a generally cylindrical loading tray 1 supported by arms 2 is arranged to swing on pivots 3 coincident with the trunnion axis between the positions shown in Figs. 1 and 2 or between the former and any other position generally comparable to the latter but corresponding to a different elevation of the gun. Thus when in its lowermost or vertical position (Fig. 1) the tray is aligned with the upper end of a tubular casing 5 of the ammunition hoist within which through the instrumentality of a vertically reciprocable trigger 6 cartridges C, C' etc. are successively delivered to the top of the hoist for projection into the loading tray. The trigger 6 of the hoist is actuated by a mechanism (not shown) which constitutes no part of the present invention, the latter being directed more particularly to the loading tray 1 which receives the cartridge after it has been elevated to the maximum extent within the capacity of the trigger 6 and the actuating mechanism which in cooperation with the tray effects transfer of the cartridges successively from the top of the hoist to position to be acted upon by the ramming mechanism of the gun.

The tray 1 is provided with spring pressed locking bolts 9 so arranged that after a cartridge has been projected into the tray by the trigger 6 and the flange on its case has initially depressed, and then passed beyond, the bolts, the latter spring outwardly below the flange to provide supports for the cartridge when the trigger 6 is subsequently retracted downward along the hoist.

To prevent the cartridge from lifting upon a quick retardation of the hoist as the cartridge is moving upwardly, a latch 10 movable vertically in the hoist with the trigger 6 is provided, this latch when projected being adapted to overlie the cartridge flange F. The latch is actuated by spring pressed arm 12 engageable with a detent 13 on the hoist housing in such manner that it is retracted from above the cartridge flange as the hoist nears the end of its upward stroke and slightly before it operates to actuate mechanism to release the tray for transfer thereby of the cartridge to the ramming mechanism as will hereafter be explained.

To swing the tray upwardly about its pivots 3 after it has received a cartridge and the trigger 6 has transferred the weight of the latter to the bolts 9 mechanism now to be described is normally brought into play automatically, the stored energy of a loaded spring or other equivalent mechanism being released to act upon the tray through a pivoted lifting arm 15 when a pair of catches 16 are disengaged from locking lugs 17 which project outwardly from the sides of the tray. The catches 16 may be actuated from a releasing bolt 18 through a lever arm 19 and link 20, and the ammunition hoist provided with a lug (not shown) movable with the trigger 6 so that upon the latter attaining substantially the highest point in its travel and thus having fully projected a cartridge into the tray, the lug moves the plunger 18 to raise the catches 16 from engagement with the locking lugs against the bias of springs 21 which normally hold the catches depressed.

Release of the catches from the lugs 17 frees the tray for swinging movement about the axis of pivots 3 and into alignment with the gun barrel under impetus supplied through lifting arm 15 from any suitable energy source. In the embodiment of the invention herein shown and described the actuating means for arm 15 include a lever 23 and link 24, the latter pivoted to plunger rod 25 the lower end of which is adapted to be releasably secured by spring catches 26 within a spring cylinder 27 to a piston 28 engaged by one end of a compression spring 29 in the cylinder.

For compressing or loading the spring 29 there is provided a pair of gears 30 meshing with racks 31 secured to the piston 28 and projecting outwardly through suitable slots in the walls of the cylinder 27, the gears 30 being actuated by means (not shown) connected with the hoist mechanism whereby when the hoist trigger 6 is retracted after having delivered a cartridge to the loading tray the gears 30 are rotated to move the racks and hence the piston 28 in the direction to compress the spring 29.

It will be appreciated, however, that any means other than those just described which are adapted to store and at the proper time release the energy requisite for swinging the loading tray 1 upwardly to ramming position (Fig. 2) from that (Fig. 1) in which it receives the cartridge may be employed if preferred.

Mechanism is also provided for controlling the travel of arm 15 in correspondence with the elevation of the gun. Thus adjacent the lower end of the cylinder 27 and projecting into a tubular extension sleeve 32 secured to the corresponding extremity of the rod 25 is mounted a plunger 33 having at its upper end a domed head entering the sleeve, the other end of the rod being secured to a lug 34 carried by a movable gear rack 35 with which a gear segment 36 is in mesh. This gear segment is actuated by a rod 37 and crank 38 through a cam follower 39 by a rotatable cam 40 and controls the position of plunger 33 in the cylinder 27 to release the piston 28 from rod 25 by tripping catches 26 in accordance with the elevational setting of the gun at the moment the tray is released from catches 16. The cam 40 is thus actuated by a train of gears 41, 42 and 43 from a gear segment 45 coaxial with the gun trunnions and fixed to the gun so as to move therewith and correspondingly correlate the position of plunger 33 in cylinder 27 with the gun elevation, the plunger occupying a higher position in the cylinder when the gun is elevated and a lower position when the gun is depressed.

A recoil jacket 46 affixed to the gun contains the ramming mechanism hereafter to be described and into alignment with which the arm 15 swings the tray 1 when the latter is released, and catches 48 on the sides of the tray are positioned to engage catch lugs 49 carried by the recoil jacket when the tray has been swung upwardly sufficiently to bring the cartridge it carries to ramming position. The ramming mechanism may be of any suitable construction, that shown in the drawings including a spring 51 disposed in a cylinder 52 operative to actuate a piston rod 53 the head 54 of which carries a feeding catch 55 adapted to engage the base of a cartridge in the raised loading tray and project it into the gun upon release of the head 54 by tripping of a lever detent 56 when a boss 57 on the tray actuates the detent at the end of the upward travel of the former, means (not shown) being provided for restoring the rammer to its initial position after it has rammed one cartridge into the gun and preparatory to the load-

ing of a succeeding round. In Fig. 2 the detent 56 has been tripped but the cocked or loaded spring 51 has not yet acted on the rammer.

As the tray is swung into ramming position it also engages a trigger arm 58 actuating a crank lever 60 biased by bolt 62 which loads a spring 63 and cushions the shock incident to arresting the upward swing of the tray.

When the rammer is released, projecting a cartridge through the tray toward the gun, the flange on the cartridge case, during passage of the latter into the gun, actuates the catches 48 on the tray to disengage them from the catch lugs 49 on the recoil jacket and the spring 63 through the bolt 62, crank 60 and arm 58 thereupon acts upon the now empty tray to swing it in the opposite direction and restore it to alignment with the ammunition hoist, the force of gravity materially aiding this return when the gun is at low elevation and to a lesser degree when the gun is raised.

Mention has been made of automatic control of the force applied to the loading tray for raising it to ramming position in correspondence with the elevation of the gun since less is required as the elevation of the gun is increased, and some further reference thereto will more fully disclose the operation of the mechanism by which this control is effected. Thus as has been explained, the rod 25 carrying at its extremity tubular extension 32 reciprocates in the cylinder 27 in correspondence with the oscillatory movement of the lifting lever 15, the latter being actuated by the rod 25 under the influence of spring 29 to raise the tray, and usually by the tray itself to raise the rod as the tray is lowered to cartridge receiving position. The tubular extension 32, provided with notches or slots 32' adapted to receive the catches 26 on the piston 28, is secured to and moves with the rod 25 whenever the latter moves and when the motive force is being derived from the spring 29 it is transmitted through the sleeve to the rod by engagement of the catches 26 in these slots locking the piston and sleeve together as a unit.

However during the downward travel of the piston, carrying with it the sleeve 32 and rod 25, as the loading tray is being swung to ramming position, when the catches 26 engage the doomed head of plunger 33 they are forced outwardly thereby and become disengaged from the slots 32', allowing the piston 28 to complete its travel independently of the rod 25 while the latter is prevented by the head of the plunger from further movement with the piston.

It is thus apparent the positioning of the plunger 33 controls the extent of travel of the arm 15 under the influence of spring 29 and as the position of the plunger corresponds directly to the gun elevation the arm 15 moves through a longer or shorter arc depending on whether the gun is at a high or a low elevation.

During the recovery operation after ramming of a cartridge and release of the tray from the recoil jacket 46 the tray re-engages the arm 15 and in returning to vertical position above the hoist is again secured by engagement of lugs 17 under latches 16. This motion of the tray also causes the arm 15 to raise the rod 25 in cylinder 27, if it has not already been so raised by operation of the hoist which in retracting the trigger 6 to engage a succeeding cartridge rotates the gears 30 to raise the piston 28. In either event, when the tray has been restored to vertical position and the piston 28 raised by the hoist to load the spring 29, the catches 26 are engaged in slots 32' of sleeve 32 to again lock the sleeve and hence the rod 25 to the piston for movement therewith in loading the succeeding round. It is therefore immaterial whether raising of the rod 25 is effected by return of the tray through arm 15 or on loading of the spring 29 by the piston 28, although it is usually by the former since the tray, after one cartridge has been rammed into the gun, quickly returns to position for receiving a succeeding one while the hoist may not be retracted for lifting the succeeding cartridge until some time after the preceding one has been rammed in the gun and the latter discharged.

Usually the travel of the arm 15 to raise the tray is effected with sufficient force and speed to make it unnecessary that it continue to engage the tray until the latter has reached ramming position, the momentum acquired by the tray and cartridge during initial upward movement normally being adequate to carry them to the latter position after further travel of the arm 15 has been arrested by the interposition of plunger 33 in the path of rod 25; the mechanism which controls the position of plunger 33 is therefore desirably designed and adjusted with this in view.

From what has been said it will be evident that the mechanism herein described is designed for use with a gun the barrel of which is mounted for vertical elevational movement about relatively horizontal trunnions whose axis extends normal to the axis of the gun barrel; as such guns are generally known no more specific description of one typical of them is required. Likewise the ammunition hoist may be of any suitable character including a generally vertical passageway referred to as the hoist shaft through which by suitable mechanism (not shown) the cartridges from the ammunition magazine are successively delivered to the tray 1, the hoist mechanism itself comprising no part of the invention and being in the same category with the gun and its trunnions in this respect. It will further be recognized that after a cartridge has been delivered through the hoist shaft to the tray 1 and deposited on the locking bolts 9 which support it when in the position illustrated in Fig. 1, release of the tray by disengagement of the catches 16 from the locking lugs 17 upon partial retraction of the hoist mechanism allows the lifting arm 15 to swing the tray upwardly in an arcuate path about the pivots 3 and thus carry the cartridge in the tray to the ramming mechanism at the position illustrated in Fig. 2. Here the tray is retained, through engagement of the catches 48 with catch lugs 49 on the gun recoil jacket, in alignment with the bore of the gun barrel into which the cartridge is projected upon actuation of the ramming mechanism. The cartridge as it moves toward the barrel releases the catches 48 and the tray is thereupon returned through the action of spring 63 and trigger arm 58 to alignment with the hoist shaft for reception of the next following cartridge, full retraction of the hoist to engage the latter causing the spring 29 to be again compressed through the action of the gears 30 and racks 31.

Control of the force which the spring 29 exerts against the plunger rod 25 in raising the tray in accordance with the elevation of the gun has been fully described but it may be repeated that the tray obviously requires greater force for its projection to ramming position when the gun is at low elevation and the ramming mechanism therefore disposed at a relatively large angle to the ammunition hoist than when the elevation of the gun is greater and the angle between the ram-

ming mechanism and hoist therefore correspondingly small.

While we have herein described with considerable particularity one embodiment of the invention it will be understood we do not desire or intend thereby to be limited or confined in any way as changes and modifications in the form, construction and relationship of the several parts of the apparatus as well as their relation to the gun assembly as a whole, including its accessory apparatus, will readily occur to those skilled in the art and may be made if desired without departing from the spirit and scope of the invention as defined in the appended claims.

Having thus described our invention, we claim and desire to protect by Letters Patent of the United States:

1. In loading mechanism for a gun comprising a gun barrel, trunnions supporting the barrel for elevational movement about a horizontal axis and a vertical hoist for delivering a projectile to a position adjacent the barrel, the combination with said gun of a loading tray for receiving a projectile from the hoist and supporting it in said position, means supporting the tray for movement in an arcuate path in the plane of said elevational movement and about an axis coincident with said horizontal axis and means for moving the tray in said path to thereby transfer a projectile in the tray from said position to one substantially in axial alignment with the barrel.

2. Means for transferring ammunition from an ammunition hoist to a trunnioned-barrel gun comprising a loading tray movable into axial alignment with the hoist to receive a projectile therefrom, means supporting the tray for oscillatory motion about an axis coincident with that of gun trunnions and in the plane of elevational motion of the gun, means carried by the tray for supporting a projectile therein in radially spaced relation to the trunnion axis and means for swinging the tray from axial alignment with the hoist to axial alignment with the gun barrel whatever be the angular position of the gun within the limits of said elevational motion.

3. Means for transferring a projectile from a vertical ammunition hoist to a position appropriate for ramming into a trunnioned-barrel gun comprising a loading tray, means supporting the tray for movement about an axis coincident with that of the gun trunnions in an arcuate path remote from said axis, means engageable with the tray operative to project it along said path from substantial axial alignment with the hoist to substantial axial alignment with the gun barrel, and means operative to arrest the action of said last mentioned means during movement of the tray along said path.

4. In means for loading a projectile into a trunnioned-barrel gun from an ammunition hoist disposed adjacent thereto, a substantially tubular loading tray, means supporting the tray for movement in an arcuate path about an axis coindent with the gun trunnion axis, a pivoted arm engageable with the tray operative to impart thereto an impetus to move the tray along said path from a position axially aligned with the ammunition hoist to one in axial alignment with the gun barrel, actuating means for said arm and means for arresting movement of the arm to thereby disengage it from the tray during said movement of the tray.

5. In means for loading a projectile into a trunnioned-barrel gun from an ammunition hoist disposed adjacent thereto, a substantially tubular loading tray, means supporting the tray for movement in an arcuate path about an axis coincident with that of the gun trunnions, a pivoted arm engageable with the tray operative to impart an impetus thereto to swing the tray from a position axially aligned with the hoist to one in axial alignment with the gun barrel, energy storing means biasing the arm in a direction to impart said impetus to the tray and releasable means for securing the tray in the first position.

6. In means for loading a projectile into a trunnioned-barrel gun from an ammunition hoist, a substantially tubular loading tray, means supporting the tray for movement in an arcuate path about an axis coincident with that of the gun trunnions, a pivoted arm engageable with the tray operative to impart to it an impetus to swing the tray in said path from substantially vertical axial alignment with the hoist to axial alignment with the gun barrel at an angle to the vertical, energy storing means biasing the arm in a direction to so swing the tray, and means controlling the action of said energy storing means in correspondence with the vertical angularity of the gun barrel to thereby limit in accordance with said angle the amplitude of movement of the arm.

7. In means for loading a projectile into a trunnioned-barrel gun from an ammunition hoist, a substantially tubular loading tray, means supporting the tray for movement in an arcuate path about an axis coincident with that of the gun trunnions, a pivoted arm engageable with the tray operative to impart to it an impetus to swing the tray from substantially vertical axial alignment with the ammunition hoist to axial alignment with the gun barrel and means for actuating the arm including a rod interconnected therewith, a compression spring surrounding the rod, an abutment engaging the spring and slidable relatively to the rod, releasable means operative to interlock the abutment and rod together for unitary movement under the influence of the spring and means for actuating said releasable means to unlock the abutment from the rod during such movement and to simultaneously arrest movement of the rod under the influence of the spring to thereby disengage the arm from the tray.

8. In loading mechanism for a trunnioned-barrel gun, a loading tray adapted to receive and support a projectile for the gun, means supporting the tray for oscillation in an arcuate path about an axis coincident with that of the gun trunnions and in the plane of elevational motion of the gun, a pivoted arm engageable with the tray for imparting thereto a swinging movement in said path from substantially vertical position to a position angular to the vertical, energy storing means interconnectable with the arm for moving it about its pivot, releasable means for interconnecting the energy storing means with said arm and means for actuating said releasable means to interrupt said interconnection during travel of the arm at a point determined by the elevation of the gun.

9. In loading mechanism for a trunnioned-barrel gun, a tray for transferring from one position to another a projectile received by the tray, means supporting the tray for oscillation in an arcuate path about an axis coincident with that of the gun trunnions and in the plane of elevational motion of the gun, means for imparting

to the tray a swinging movement in said path towards the second position, interengageable means carried respectively by the tray and the gun for releasably holding the tray in the second of said positions after it has been swung thereto and projectile-actuated means for releasing said interengageable means.

10. In loading mechanism for a trunnioned-barrel gun, a tray for transferring from one position to another a projectile received by the tray, means supporting the tray for oscillation in an arcuate path about an axis coincident with that of the gun trunnions and in the plane of elevational motion of the gun, a pivoted arm engageable with the tray for imparting thereto a swinging movement in said path towards the second of said positions, means for actuating the arm, energy storing means disposed adjacent said second position including means engageable by the tray operative to arrest motion of the tray when it attains substantially said second position, latching mechanism for releasably securing the tray in said second position and projectile-actuated releasing means therefor.

11. In means for transferring projectiles successively from a substantially vertical ammunition hoist to a position angular to the vertical in alignment with the bore of a trunnioned-barrel gun, a loading tray operative to receive and support remote from the gun trunnion axis a projectile delivered to the tray by the hoist, means supporting the tray for movement about an axis coincident with said trunnion axis in the plane of elevational movement of the gun and means for moving the tray from substantial axial alignment with the hoist to said position for projection of a projectile from the tray into the gun.

12. In means for transferring projectiles successively from a substantially vertical ammunition hoist to position adjacent a trunnioned-barrel gun having its barrel disposed at an angle to the vertical in a plane containing the vertical axis of the hoist, a loading tray operative to receive and support remote from the gun trunnion axis a projectile delivered to the tray by the hoist, means supporting the tray for movement in said plane about an axis coincident with said trunnion axis, and means for moving the tray in an arcuate path in said plane from substantial axial alignment with the hoist to substantial axial alignment with the gun barrel irrespective of its angular elevation to thereby position a projectile in the tray for projection directly therefrom into the gun, said last mentioned means including an arm pivoted for movement about an axis parallel to but remote from said trunnion axis and engageable with the tray when the latter is aligned with the hoist and yielding means for moving the arm in one direction about its axis while in engagement with the tray.

13. In projectile transferring means as defined in claim 12 means for interrupting movement of the arm during movement of the tray whereby the tray attains substantial alignment with said barrel by virtue of the momentum imparted it by the arm.

14. In projectile transferring means as defined in claim 12 means for interrupting movement of the arm while the tray is moving toward said alignment with the barrel whereby the tray attains said position by virtue of the momentum imparted thereto by the arm and means for controlling the amplitude of travel of the arm in correspondence with the angle of the gun to the vertical.

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