A loading mechanism for guns, in which the loading tray is moved from its delivery position to its pick-up position by a pair of levers mounted on separate, fixed fulcrums on the gun mounting the levers also being pivotally connected, the first to the loading tray and the second to a member slidable along the first lever. The second lever is engaged and rotated, on recoil of the gun, by a recoiling part to actuate the loading tray.
LOADING MECHANISM FOR GUNS

This invention relates to loading mechanisms for guns and is particularly concerned with a lever linkage, actuated by recoil of a gun after firing, for governing the motion of a loading tray by means of which rounds of ammunition are collected from a source, such as a magazine, and presented to the gun for insertion into the breech. The object of this linkage is to impart to the tray a required motion which is preferably of a type, hereinafter called a simple harmonic type motion, such that the tray, in a single stroke, moves from one rest position to another, accelerating to and being retarded from a maximum velocity occurring at an intermediate point (though not necessarily the mid-point) of its travel.

The invention comprises, in a loading mechanism for a gun, a loading tray constrained to follow a predetermined path of movement; a tray lever having a fulcrum fixed relative to the gun mounting, said tray lever also being pivotally connected to the tray; an actuating lever having another fulcrum fixed relative to the gun mounting, said actuating lever engaging the tray lever by means of a pivot which is movable longitudinally with respect to the said tray lever; and means carried by the recollecting parts of the gun, for engaging and operating the actuating lever to impart a required motion to the loading tray.

In order to obtain the preferred, simple harmonic type motion of the loading tray, the lever fulcums are preferably so positioned that, at one end of the stroke of the loading tray, the levers are substantially mutually perpendicular and the means carried by the recollecting parts of the gun for engaging and operating the actuating lever is such that, at the other end of said stroke, the angular velocity of the actuating lever is substantially zero.

The path of the loading tray is preferably rectilinear and perpendicular to the gun axis and the stroke of the tray occurring during recoil of the weapon carries it from rest at a delivery position athwart the gun axis, by way of the simple harmonic type motion, to a second rest position, which will be referred to as the pick-up position, where it collects a new round from the magazine. The return stroke, delivering the new round to a position on the gun axis ready for ramming, may be made under the action of a spring and may be initiated at a suitable instant by tripping, at an appropriate time, for example as the gun completes its run-out, a spring catch which is arranged to retain the tray in the pick-up position until the weapon is ready for delivery of the new round.

It has been found very suitable that the engagement between the actuating lever and its operating means, carried by the recollecting parts of the weapon, should be such that the point of engagement moves in a circular arc relative to the recollecting parts. This may be achieved, for example, by engagement of a pin on the actuating lever with the free end of a rotor arm pivoted upon a recollecting member such as the breech ring, the lever and rotor arm being maintained pivotally connected during the required movement of the loading tray. An alternative method is to provide on the breech ring, a cylindrical cam surface which engages the actuating lever to impart the desired motion. By using a somewhat differently shaped cam it would be possible, should this be desired, to introduce some variation in the pattern of acceleration and retardation of the loading tray.

Two forms of the invention will now be described more particularly, by way of example only, with reference to the accompanying drawings in which:

FIG. 1 is a view of the underside of the breech end of a gun showing one form of loading mechanism, other parts such as breech mechanism, extractor mechanism, recuperator etc., which do not form part of the present invention having been omitted for the sake of clarity, and

FIG. 2 is a similar view showing a modified form of loading mechanism.

In the above views, identical parts have been accorded the same numerals in both figures. Parts shown in FIG. 2 which are equivalent and similar but not identical with those of FIG. 1, have been given the same numeral as the equivalent part in FIG. 1 but with suffix "a".

As shown in FIG. 1, a loading tray 1 is arranged to travel along a guideway 2 perpendicular to the gun axis 3 between a delivery position athwart the gun axis and a pick-up position where a round of ammunition is inserted into the tray from a magazine (shown only in part outline at 20), the round being carried to the delivery position on the return stroke of the tray. A tray lever 4 is pivoted, at an intermediate point 5 of its length, to the cradle or mounting 6 of the weapon at a point below the level of the gun axis 3, the pivotal axis being perpendicular to the gun axis and to the loading tray guideway 2. One end of the lever 4 is pivotally connected to a small shoe 7 slidably mounted in a groove 8, parallel to the gun axis 3, formed in the underside of the loading tray 1, the tray lever 4 extending forwardly therefrom, toward the gun muzzle, approximately parallel to the gun axis 3 and on the magazine side thereof. In that arm of the tray lever 4 remote from the tray 1, is formed a longitudinal slot 9 which, at its inner end, curves toward the gun axis 3 as shown at 10.

An actuating lever 11, is also pivoted, at an intermediate point 12 of its length, to the cradle 6, its pivotal axis being parallel to that of the tray lever 4 and located on the same side of the tray lever 4 as the gun axis 3, on a line perpendicular to the gun axis and intersecting the tray lever 4 at approximately the point where the slot 9 therein begins to curve. One end of the actuating lever 11 is pivotally connected 29 to a slide 13 which is movable along the slot 9 in the tray lever 4. The curved portion 10 of the slot 9 is radiused upon the pivot 12 of the actuating lever 11 so that movement of the slide 13 in this part of the slot causes no movement of the tray lever 4. The free end of the actuating lever 11 carries a pin 14 extending parallel to its pivotal axis. The pin 14 is in the form of a cylindrical segment, slightly greater than a semi-cylinder, having a plane face 15 on the side thereof facing the lever pivot 12. A torsion spring 24, located about the pivotal axis of the actuating lever 11, biases the lever linkage toward the position occupied when the loading tray 1 is in the delivery position (shown in full lines).

Carried on the underside of the breech ring 16 of the gun 17 is a rotor arm 18 extending rearwardly from a pivot 19 whose axis is parallel to those of the lever pivots 5, 12. The rotor arm 18 is spring biased 23
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3 toward a position, parallel to the gun axis, in which it is aligned with the pin 14 on the actuating lever 11 when the loading tray 1 occupies its delivery position. The free end of the rotor arm 18 is in the form of a claw 21 consisting of circular aperture in the end of the arm a section of whose rim is cut away to provide an entry to the claw 21 extending over a little more than 90° of the rim. This entry 22 is on the side of the aperture remote from the pivots 19, 12 of both the arm 18 and the actuating lever 11.

Just before firing the mechanism is in the delivery position, as shown in full lines, with the pin 14 of the actuating lever 11 lying in the claw 21 of the rotor arm 18. On firing the gun and breech ring recoil and the rotor arm 18 moves rearward carrying with it the pin 14 of the actuating lever 11. Owing to their interengagement, both the rotor arm 18 and the actuating lever 11 begin to pivot about their respective axes 19, 12 and, at once, the pin 14 and claw 21 become locked owing to their relative rotation. The slide 13 at the other end of the actuating lever 11 begins to move along the slot 9 of the tray lever 4 which begins to turn, accelerating gradually from zero angular velocity since initially the actuating and tray levers are perpendicular. The loading tray 1 moves away from the gun axis 3, accelerating from rest to a maximum velocity whereafter the velocity falls again as the tray approaches the pick-up position (in which the levers are shown in chain dotted lines) which occurs when the rotor arm 18 has turned through a right angle and the pin 14 of the actuating lever 11 is again aligned with the entry to the claw 21. In this position the actuating lever 11 is arranged to be parallel to the gun axis 3 and its angular velocity and, hence, the velocity of the loading tray 1 will have decreased to zero. Further recoil of the gun now causes the rotor arm 18 to disengage the pin 14 and to return to its initial position parallel to the gun axis under the action of its spring 23, the loading tray 1 and the lever linkage being meanwhile retained in the pick-up position by means of a spring catch (not shown in the drawings) which may take any one of many known forms.

The mechanism remains in the pick-up position until the spring catch is released at or near the end of run-out of the weapon whereafter it is returned to the delivery position by means of the torsion spring 24 acting upon the actuating lever 11. While the mechanism is retained in the pick-up position a new round enters the loading tray 1 from the magazine 20. The mechanism by means of which this is achieved forms no part of the present invention and is not therefore described. Since the run-out position varies somewhat from round to round, excess run-out is catered for by the curved portion 10 of the slot 9 in the tray lever 4, which permits the actuating lever 11 to overshoot without causing further rotation of the tray levers 4.

In a modification (FIG. 2), the rotor arm 18 is replaced by a cam surface 25 carried by the breech ring 16. This surface, which is part cylindrical, is arranged to define a circular path similar to that of the outer end of a rotor arm and will clearly impart the same type of motion to the actuating lever 11a. In order to ensure smooth operation of the mechanism it is desirable to use a gated cam having a spring loaded gate 26 which defines a cam groove 27 during recoil (the gate position during this stage being shown in chain lines) but which can move, under the action of its spring 28, clear of the actuating lever 11a on run-out of the gun. In this modification the pin 14a carried at the end of the actuating lever 11a is used to engage the cam surface 25 and may be of simple cylindrical form or it may be replaced by a cam following roller. The tray lever 4a is, in this case provided with a simple straight slot 9a and owing to variation of the position of its pivot 5a is inclined at a small angle to the gun axis 3.

It will be clear that many variations may be made in the mechanism herein described without departing from the scope of the invention. For example, it will be clear that a large variety of arrangements of levers and their pivot positions, within the limitations hereinbefore defined, can be used to carry out the invention. The shoe 7 and slide 13 cooperating with the groove 8 and slot 9 respectively can clearly be replaced by sleeves sliding on bars or rails. The spring catch for retaining the loading tray in the pick-up position, and its release mechanism can obviously be of any one of many suitable designs. The lengths of the various levers and the rotor arm can, of course by varied to give the loading tray any desired length of movement.

1: In a gun carried in a mounting relative to which it can recoil on firing; a loading mechanism, incorporating a loading tray constrained to follow a predetermined path of movement; a tray lever having a fulcrum fixed relative to the gun mounting; said tray lever also being pivotally connected to the tray; an actuating lever having another fulcrum fixed relative to the gun mounting; a pivotal connection by means of which the actuating lever engages the tray lever, which connection is movable longitudinally with respect to said tray lever and means, carried by the recoiling parts of the gun, for engaging and operating the actuating lever to impart a required motion to the loading tray; wherein the lever fulcums are so positioned that at one end of the stroke of the loading tray the levers are substantially mutually perpendicular, and the means carried by the recoiling parts for engaging and operating the actuating lever is such that at the other end of the said stroke the angular velocity of the actuating lever is substantially zero; and wherein the required motion of the loading tray is a simple harmonic type motion such that the tray, in a single stroke, moves from one rest position to another accelerating to and being retarded from a maximum velocity which occurs at an intermediate point of its travel.

2. A loading mechanism as claimed in claim 1 wherein the path of the loading tray is rectilinear and perpendicular to the gun axis; the tray being moved, during recoil of the gun, from rest at a delivery position athwart the gun axis, by way of a simple harmonic type motion to a pick-up position to collect a new round from a magazine.

3. A loading mechanism as claimed in claim 2 wherein is incorporated a spring by the action of which the loading tray is returned, at an appropriate time, to its delivery position.

4. A loading mechanism as claimed in claim 1 wherein the means carried by the recoiling parts is such that its point of engagement with the actuating lever moves in a circular arc relative to said recoiling parts as the gun recoils.
5. In a gun carried in a mounting relative to which it can recoil on firing; a loading mechanism, incorporating a loading tray constrained to follow a predetermined path of movement; a tray lever having a fulcrum fixed relative to the gun mounting, said tray lever also being pivotally connected to the tray; an actuating lever having another fulcrum fixed relative to the gun mounting; a pivotal connection by means of which the actuating lever engages the tray lever, which connection is movable longitudinally with respect to said tray lever and means, carried by the recoiling parts of the gun, for engaging and operating the actuating lever to impart a required motion to the loading tray; wherein the means carried by the recoiling parts is such that its point of engagement with the actuating lever moves in a circular arc relative to said recoiling parts as the gun recoils, a rotor arm pivoted upon a recoiling part and constituting the said means; a claw carried at the free end of said rotor arm and a pin carried by the actuating lever; the said claw being arranged to engage and maintain engagement with the said pin, during at least a part of the recoil of the gun, to actuate the loading mechanism.

6. A loading mechanism as claimed in claim 5 incorporating a guideway fixed upon the gun mounting and extending transversely of the gun axis; the loading tray being moveable, during recoil of the gun, along said guideway from a delivery position athwart the gun axis to an off-axis pick-up position to receive a new round of ammunition; the fulcrum of the tray lever being located forward of said guideway and at an intermediate point of the lever which extends forwardly from the loading tray substantially parallel to the gun axis when the tray is in the delivery position; the fulcrum of the actuating lever being located at an intermediate point thereof and on that side of the tray lever remote from that toward which the loading tray moves during recoil, said actuating lever extending, when the tray is in the delivery position, perpendicular to said tray lever from its pivotal connection therewith, which is located forward of the tray lever fulcrum; the pin being mounted at that end of the actuating lever remote from the tray lever; and the rotor arm, prior to recoil of the gun, extending rearwardly toward the actuating lever, substantially parallel to the gun axis, from its pivot on the recoiling part, its claw being aligned with the pin on the actuating lever.

7. A loading mechanism as claimed in claim 6 wherein the pin carried by the actuating lever is of D-shaped cross section, its flat side being toward the actuating lever fulcrum; and the claw on the rotor arm is in circular form having an opening extending over that quadrant remote from the pivots of both rotor arm and actuating lever, said opening being aligned, prior to recoil, with the D-shaped pin whereby, when the claw and pin are engaged and the rotor arm begins to rotate, the claw and pin become locked in engagement until the rotor arm has rotated through 90°.

8. In a gun carried in a mounting relative to which it can recoil on firing; a loading mechanism, incorporating a loading tray constrained to follow a predetermined path of movement; a tray lever having a fulcrum fixed relative to the gun mounting, said tray lever also being pivotally connected to the tray; an actuating lever having another fulcrum fixed relative to the gun mounting; a pivotal connection by means of which the actuating lever engages the tray lever, which connection is movable longitudinally with respect to said tray lever and means, carried by the recoiling parts of the gun, for engaging and operating the actuating lever to impart a required motion to the loading tray; wherein the means carried by the recoiling parts is such that its point of engagement with the actuating lever moves in a circular arc relative to said recoiling parts as the gun recoils; a cylindrical cam surface carried by a recoiling part and constituting said means and a cam follower carried by the actuating lever; said cam surface being arranged to engage said cam follower during at least a part of the recoil of the gun to actuate the loading mechanism.