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TITLE: "System for decoupling a carrier for a piece of ammunition of a firearm"

DESCRIPTION

5 Technical field

The present invention relates to a system for decoupling a carrier for a piece of ammunition, and to a firearm comprising such a system.

Technical background

10 Systems are known in the industry for loading a piece of ammunition into a firearm, particularly into large-calibre firearms, such as naval artillery guns. Some known systems utilize part of the recoil energy to load a new piece of ammunition into the firearm.

15 With a view to increasing the firing rate, however, the need is felt for a system which, while being reliable, can load ammunition into a firearm at a high frequency.

Summary of the invention

20 It is one object of the present invention to provide a system for decoupling a carrier for a piece of ammunition which can overcome the drawbacks of the prior art.

According to the present invention, this and other
25 objects are achieved through a system having the

technical features set out in the appended independent claim.

It is understood that the appended claims are an integral part of the technical teachings provided in the following detailed description of the present invention. In particular, the appended dependent claims define some preferred embodiments of the present invention that include some optional technical features.

Further features and advantages of the present invention will become apparent in light of the following detailed description, provided herein merely as a non-limiting example and referring, in particular, to the annexed drawings as summarized below.

Brief description of the drawings

Figure 1 is a perspective transparency view of a part of a system for decoupling a carrier for a piece of ammunition, in particular of a carrier recuperator, according to an exemplary embodiment of the present invention.

Figures 2a and 2b are sectional side views of the carrier recuperator in two different operating conditions.

Figures 3 and 4 are perspective views of the rearming transmission.

Figure 5 is a side view of the rearming

transmission.

Figure 6 is a sectional front view of the rearming transmission.

Figures 7a-g are side views of an operating sequence
5 of the rearming transmission.

Figures 8a-h are side views of an operating sequence of the system according to the invention.

For completeness' sake, the following is a list of alphanumerical references used herein to identify parts,
10 elements and components illustrated in the above-summarized drawings.

- 2. rammer
- 7. carrier end-of-stroke damper
- 8. recoiling mass
- 15 10, 11. retaining rods
- 10. carrier recuperator
- 11. first cylinder
- 12. second cylinder
- 14. upper lever
- 20 15. release lever
- 16. primary chamber of first cylinder
- 21. second axis of rotation
- 13, 22. fulcrum lever
- 23. wall
- 25 24. passage

- 29. shaft
- 32. release piston
- 33. angle lever
- 42. piece of ammunition
- 5 51. pressure gauge
- 55. toothed sector
- 56. filling valve
- 57. plug
- 60. carrier recuperator
- 10 61. rack
- 62. slotted link lever
- 63. first piston
- 64. non-return valve
- 65. needle valve
- 15 66. primary chamber of second cylinder
- 67. second piston
- 68. secondary chamber
- 69. roller
- 84. release element
- 20 85. rods
- 86. revolving support
- 91. permission lever
- 92. release lever
- 93. rearming lever
- 25 102. cradle

- 106. oscillating lever
- 111. first cylinder
- 112. second cylinder
- 114. carrier
- 5 116. cam
- 135, 136. articulated transmissions
- 137, 138. straight guide
- 140. damper
- 141. pin
- 10 142, 143. articulated connecting rods
- 144, 148. crank lever
- 145, 149. stopper
- 146. rearming return means
- 147. gun safety device
- 15 150. rearming lever end-of-stroke damper
- 151. idle lever
- 153. first axis of rotation
- 154. slider
- 155. safety hook
- 20 156, 160. splined lever
- 157. spring
- 158. fulcrum
- 159. support blocks
- 161. shaft
- 25 163. contact block

164. control stud

Detailed description of the invention

With reference to the drawings, there is shown a system for decoupling a carrier for a piece of ammunition, comprising: a carrier recuperator 60, including: a first and a second cylinder 111, 112 respectively comprising a first and a second piston 63, 67; wherein each piston 63, 67 defines, in the respective cylinder 111, 112, a primary chamber 16, 66 full of liquid, and the two primary chambers 16, 66 are in fluidic communication with each other to allow a flow of liquid; second piston 67 defines, in second cylinder 112, a secondary chamber 68 containing a return medium for moving second piston 67 and pumping the liquid into primary chamber 16 of first cylinder 111.

The system also includes a carrier rearming transmission, comprising:

- a first and a second articulated connecting rod 142, 143 hinged to a fulcrum 158, wherein first connecting rod 142 is also hinged to a recoiling mass 8 of a firearm,
- a straight guide 137, 138 whereon articulated connecting rods 142, 143 are intended to abut and slide,
- a rearming lever 93 freely rotatable

about a first axis of rotation 153, and having a slider 154 at a first end thereof,

• a slotted link lever 62 rotatable about a second axis of rotation 21, and having a guide in which slider 154 of rearming lever 93 is slidably mounted, wherein first piston 63 is connected to slotted link lever 62 in such a way as to constrain the motion of first piston 63 to the rotation of slotted link lever 62,

• a crank lever 144, 148, rotatable about first axis of rotation 153, having a first end connected to the recoiling mass through the two articulated connecting rods 142, 143, and configured to interfere with the rotation of rearming lever 93,

• a release transmission configured to guide the movement of the carrier and to selectively hold in position and release rearming lever 93; wherein first piston 63 is connected to the release mechanism in such a way as to constrain the motion of first piston 63 to a movement of the carrier.

Carrier recuperator 60 supplies the energy necessary to lower carrier 114 and push the piece of ammunition into the barrel. Carrier 114 is, therefore, a loading carrier. Recuperator 60, which in the example

shown herein is a hydropneumatic one, stores the recoil energy of the recoiling mass when carrier 114 is rearmed into the raised position.

Recuperator 60 is configured to store energy from
5 recoiling mass 8, to which it is connected, after the recoil, and to subsequently release such energy in order to lower carrier 114, to which it is also connected. In particular, the return medium, preferably a gas, in recuperator 60 is adapted to store and release such
10 energy.

Preferably, first cylinder 11 has orifices adapted to be crossed by the fluid when first piston 63 moves outwards (i.e. when the volume of first chamber 16 increases), particularly in the final part of the outward
15 stroke. Preferably, with second cylinder 12 a non-return valve 64 is associated which has orifices adapted to be crossed by the fluid when first piston 63 moves inward (i.e. when the volume of first chamber 16 decreases), particularly in the final part of the inward stroke.
20 Such orifices are used to reduce the speed of the first piston 63. Conveniently, there is an end-of-stroke damper 7 for carrier 114, which damps the motion of the carrier towards its upper and lower stoppers.

Conveniently, there is an end-of-stroke damper 150
25 for rearming lever 93.

The decoupling system of the present invention is intended to be housed in a cradle 102, drawn with a dashed line in Fig. 1. The decoupling system can be installed, by way of non-limiting example, on armed
5 vehicles such as warships or terrestrial military vehicles.

Preferably, the return medium in secondary chamber 68 is a gas, conveniently nitrogen. As an alternative to a gas, an elastic means like a spring may be used.

10 In particular, the two cylinders 11, 12 are adjacent to each other. A passage 24 puts primary chambers 16, 66 of cylinders 11, 12 in fluidic communication with each other. In the example, they 11, 12 form a single external body. In the example, a wall 23 of first cylinder 11 is
15 also a wall 23 of second cylinder 12. In other words, wall 23 separates the two cylinders 11, 12. In said wall 23 there is passage 24, which puts the two primary chambers 16, 66 in communication with each other. In particular, passage 24 is always open.

20 Preferably, the liquid intended to flow between the two primary chambers 16, 66 is oil. Conveniently, a filling valve 56 is associated with first cylinder 11 to allow a flow of liquid (preferably oil) from the outside towards primary chamber 16 of first cylinder 11. Through
25 filling valve 56 it is possible to supply liquid from

the outside into primary chamber 16, and, if necessary, to remove liquid from said primary chamber 16. In second cylinder 12, second piston 67 separates primary chamber 66 from secondary chamber 68.

5 In the example, first piston 63 is integrally connected to a rack 61, which in this specific example is a toothed rod. Rack 61 is engaged with a toothed sector 55, or a toothed wheel, to form a rack-and-pinion mechanism. Optionally, a roller 69 is provided for
10 guiding rack 61.

 In the example, the gas is delivered into secondary chamber 68 through a valve 65, particularly a needle valve, formed in the rod of second piston 67. In more detail, a plug 57 closes valve 65. Conveniently, a
15 pressure gauge 51, mounted on cradle 102 in the example, measures the gas pressure in secondary chamber 68.

 The following will describe the operation of carrier recuperator 60 with reference to Figures 2a and 2b.

20 a. Fig. 2a. Carrier 114 in raised position. When carrier 114 is in this position, pistons 63, 67 are retracted in the respective cylinders 111, 112.

 Primary chamber 66 of second cylinder 112 has its maximum volume, and the gas pressure in secondary chamber
25 68 is at its highest value.

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b. Release of carrier 114. As soon as carrier 114 is released, the gas pressure in secondary chamber 68 forces first piston 67 to move backwards, thereby delivering pressurized liquid into primary chamber of first piston 63. First piston 63 thus comes out and causes toothed sector 55 to rotate, thereby lowering carrier 114. In the final part of the outward stroke of first piston 63, the fluid in primary chamber 16 of first cylinder 111 preferably crosses the calibrated orifices, thus generating a resistant load that slows down carrier 114 as it approaches its lower end-of-stroke position.

c. Fig. 2b. Lowered carrier 114. When carrier 114 is in the lowered position, pistons 63, 67 are fully out. Primary chamber 66 of second piston 67 has its minimum volume, and the gas pressure in secondary chamber 68 is at its lowest value.

d. Rearming of carrier 114. Under the action of the rearming transmission, toothed sector 55 rotates, thereby simultaneously causing, through rack 61, carrier 114 to rise and first piston 63 to retract. The liquid contained in the primary chamber of first cylinder 111 is pushed into primary chamber 66 of second cylinder 112; thus, second piston 67 retracts, thereby causing the gas in secondary chamber 68 to be compressed until carrier 114 reaches its upper stopper (i.e. until it

returns into the configuration of Fig. 2a). In the final part of the return stroke of first piston 63, the fluid in primary chamber 16 of first cylinder 111 crosses the calibrated orifices provided on a non-return valve 64, 5 thereby generating a resistant load that slows down carrier 114 as it approaches its upper end-of-stroke position.

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In particular, the two articulated connecting rods 10 142, 143 have the same length. In particular, the distance between the hinge points at the ends of each connecting rod 142, 143 is the same. In the example, second connecting rod 143, which is one of said two articulated connecting rods, is hinged to the first end 15 of crank lever 144, 148. Conveniently, a damper 140 is mounted to recoiling mass 8, and first connecting rod 142 is hinged to said damper 140. Thus, the recoil occurring after the piece of ammunition has been fired causes a weaker impact against the rearming transmission 20 and the other components connected thereto. A weaker impact is also produced when recoiling mass 8 returns into the firing position, dragging along connecting rods 142, 143. In more detail, damper 140 is associated with a spring 157, which may optionally be adjustable. The 25 spring is interposed between recoiling mass 8 and

connecting rod 142.

Recoiling mass 8 is adapted to assume a firing position, in which it is ready to fire. In the figures showing the operating sequences of the invention, the firing position of recoiling mass 8 is on the right. Therefore, after having fired a round, recoiling mass 8 will move to the left along the recoil direction.

Straight guide 137, 138 is intended to stay in a fixed position. For example, such guides 137, 138 are integral with cradle 102. When recoiling mass 8 is in firing position 8, articulated connecting rods 142, 143 are aligned along a straight axis. In this position, guide 137, 138 is parallel to articulated connecting rods 142, 143. In the example shown herein, fulcrum 158 comprises a pin adapted to abut and slide against guide 137, 138. Preferably, said pin is cam-shaped to co-operate with guide 137, 138. In more detail, the pin of fulcrum 158 crosses two holes formed in the respective end of each one of the two articulated connecting rods 142, 143.

Preferably, there is a support block 159 whereon fulcrum 158 of articulated connecting rods 142, 143 is adapted to slide, and which co-operates with the straight guide to keep connecting rods 142, 143 aligned along a tract of the stroke after the recoil motion has started.

Fulcrum 158 is interposed between support block 159 and guide 137 along a part of the stroke, particularly starting from the point where recoiling mass 8 is stationary and ready to fire until a part of the recoil stroke has been completed. For example, connecting rod 143 has a bulge adapted to rest on block 159.

In particular, the release mechanism comprises a release element 84 which is movable and configured to selectively hold in position and release one end of rearming lever 93. In particular, release element 84 is rotatable about an axis of rotation of its own. In the example, release element 84 is a release lever. Release element 84 is configured to abut against the end of rearming lever 93.

In particular, release element 84 is constrained to carrier 114, so that the position of carrier 114 determines the position of release element 84. Release element 84 is bound to the position of carrier 114, as will be explained hereinafter. Release element 84 is adapted to assume a locking position, in which it 84 is engaged with rearming lever 93, and at least one release position, in which it 84 permits the rotation of rearming lever 93. The position of carrier 114 determines whether release element 84 is in the locking position or in the release position.

Preferably, slotted link lever 62 is integral with toothed sector 55, which is engaged with a rack 61 integral with first piston 63. Therefore, also toothed sector 55 is rotatable about second axis of rotation 21.

5 In particular, the guide of slotted link lever 62 is straight. In the example, the guide of slotted link lever 62 is a slot. In particular, slider 154 is a sliding block. Slider 154 is in proximity to one end of rearming lever 93. Therefore, levers 62 and 93
10 essentially form a slotted link mechanism. In the example, that end of rearming lever 93 which is closest to slider 154 is adapted to abut on and engage with release element 84.

In the preferred example shown herein, there are
15 two crank levers 144, 148 coaxial and rotatably constrained to each other, in particular having the same angular position. Each crank lever 144, 148 co-operates with its stopper 145, 149. The two crank levers 144, 148 are arranged on two sides, e.g. right and left, of
20 recoiling mass 8. In the example, there is only one rearming return means 146, acting upon the respective crank lever 144.

In the example there are two pairs or articulated connecting rods 142, 143, in particular positioned on
25 two sides, e.g. right and left, of recoiling mass 8.

Therefore, there are two articulated transmissions 135, 136 on both sides of recoiling mass 8. In more detail, the two pairs of articulated connecting rods 142, 143 have the same shape. There are two first connecting rods 142 and two second connecting rods 143. Each pair of articulated connecting rods 142, 143 is constrained to the respective crank lever 144, 148, as well as to recoiling mass 8.

In the example there are only one rearming lever 93 and only one slotted link lever 62.

Articulated connecting rods 142, 143 constitute an articulated transmission 136. Recoiling mass 8 may be a portion of a firearm. By way of non-limiting example, it may be a portion of an artillery gun.

The rearming transmission brings carrier 114 back into the raised position after firing has occurred. For this task, the rearming transmission uses part of the recoil energy of recoiling mass 8 in order to:

- directly raise carrier 114, and
- recharge carrier recuperator 60, which stores the energy necessary for lowering carrier 114 for the next ramming operation.

Crank lever 144, 148 is configured to interfere with the rotation of rearming lever 93. According to a preferred embodiment, crank lever 144, 148 interferes

with rearming lever 93 through elements interposed between such levers 144, 148, 93. In particular, an idle lever 151, integral with crank lever 144, 148, is adapted to abut against a second end of rearming lever 93.

5 According to one possible variant of the invention, crank lever 144, 148 is adapted to directly abut against a second end of rearming lever 93. Crank lever 144, 148 is, in general, adapted to rotatably engage rearming lever 93 for a part (in particular, for a part only) of

10 the angular stroke of said rearming lever 93.

In the example shown herein, the rearming transmission comprises an idle lever 151, in particular a crank lever, rotatable about first axis of rotation 153 and rotatably constrained to crank lever 148. Idle

15 lever 151 is adapted to abut against a second end of rearming lever 93. Idle lever 151 acts as a stopper for rearming lever 93 during the downward movement of carrier 114, and is adapted to push rearming lever 93, in particular by means of a contact block 163, during the

20 upward movement of carrier 114. Idle lever 151 is adapted to abut against rearming lever 93 for a part (in particular, for a part only) of the angular stroke of said rearming lever 93. In the non-limiting example shown herein, idle lever 151 is mounted to a crank 152 by means

25 of a ball joint 162. Crank 152 can rotate integrally

with crank lever 148 about first axis of rotation 153.
In particular, the two axes of rotation 21, 153 are
parallel to each other.

The following will describe the operation of the
5 rearming transmission with reference to Figures 7a-g.

Carrier up and engaged (Figure 7a). Carrier 114 is
engaged in the raised position:

- rearming lever 93 is held rotated downwards by
release element 84, and in its turn holds slotted link
10 lever 62, and hence carrier 114, in the raised position;

- crank levers 144 and 148 are abutting on their
stoppers 145 and 149;

- articulated connecting rods 142, 143 are
extended, and in particular are loaded by springs 157 of
15 dampers 140.

Release of loading carrier (Figure 7b). The release
transmission has been actuated:

- release element 84 has released rearming lever
93, thus allowing slotted link lever 62 to rotate under
20 the action of carrier recuperator 60, thus lowering
carrier 114;

- rearming lever 93 is made to rotate clockwise by
slotted link lever 62 through slider 154;

- articulated connecting rods 142, 143 and crank
25 levers 144, 148 are still in the idle position.

Carrier 114 in the lowered position (Figure 7.c). After having been released, carrier 114 reaches the lowered position; the rearming transmission is in the following condition:

- 5 - articulated connecting rods 142, 143 are still extended and loaded by springs 157 of dampers 140;
- crank levers 144, 148 are in the idle position in abutment with their stoppers 145, 149;
- rearming lever 93 is in the vertical position
- 10 and, particularly via its block 163, is in contact with the corresponding block of idle lever 151, so that it 93 is acting upon crank lever 144, 148;
- in-battery gun safety hook 155 is not interfering with control stud 164 of the right-hand lever controlling
- 15 the spring-type recuperator of the breechblock: the breechblock can close and the gun can fire.

Recoil start (Figure 7d). After firing, the gun starts recoiling:

- the articulated transmissions, held in the
- 20 extended position by the combined action exerted by guides 137, 138, fulcrum 158, and support blocks 159 of the breechblock on the rear articulated connecting rods 143, transmit the recoil motion to the crank lever system;
- 25 - safety hook 155 interferes with control stud 164

of the lever (e.g. the right-hand lever) controlling the spring-type recuperator of the breechblock, thus keeping splined lever 156 in the lowered position and forcing connecting rods 142 and 143 to remain aligned;

5 - crank levers 144 and 148 start rotating counterclockwise, thereby causing idle lever 151 to drag along rearming lever 93;

 - rearming cam 93 in turn causes, by means of its slider 154, slotted link lever 62 to rotate clockwise,
10 thereby lifting carrier 114 and recharging carrier recuperator 10.

 Recoil at 200 mm from battery (Figure 7e). When recoiling mass 8 reaches a distance of 200 mm from the in-battery position (where it is ready to fire), carrier
15 114 is fully rearmed:

 - crank levers 144 and 148 have reached their rotation stopper, and rearming lever 93 has engaged release lever 84 of the carrier release transmission;

 - fulcrum 158 of the front articulated connecting
20 rod 143 is no longer controlled by the upper edge of guide 138, and in-battery gun safety hook 155 is no longer interfering with control stud 164 of the lever controlling the spring-type recuperator of the breechblock, thus freeing splined lever 156 and allowing
25 the articulated transmission (articulated connecting

rods 142, 143) to kneel.

Recoil from 200 mm to maximum recoil (230 mm from battery, Figure 7f). As soon as the position at a distance of 200 mm from the in-battery position is
5 passed, the bottom edge of guide 138 forces pin 158 upwards, thereby starting the kneeling of the articulated transmission:

- pin 158, which is no longer retained by guide 138 and splined lever 156, allows the front and rear
10 articulated connecting rods 142 and 143 to kneel under the action of crank levers 144 and 148 loaded by return spring 146;

- crank levers 144 and 148, which are no longer connected to recoiling mass 8, snap into their idle
15 position against stoppers 145 and 149 under the action of return spring 146;

- rearming lever 93, and hence carrier 114, is stopped and locked by release lever 84 of the carrier release transmission.

20 Return to battery of gun (Figure 7g). As the gun is returning to battery, the articulated transmission returns into the non-kneeled position, passing with pin 158 over guide 138:

- in-battery gun safety hook 155 is held in the
25 position in which it interferes with the stroke of the

right-hand lever controlling the spring-type recuperator of the breechblock, thus preventing the breechblock from closing, until the articulated transmission is fully extended;

5 - crank levers 144 and 148 do not intervene during the phase of returning to battery, remaining in their idle position;

 - rearming lever 93 is kept locked by release lever 84 until the release transmission is actuated by a new
10 piece of ammunition falling onto carrier 114.

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 In particular, the system includes a gun safety device 147, configured to prevent a breechblock of the firearm from closing completely, which would result in
15 the piece of ammunition being fired, until articulated connecting rods 142, 143 become aligned. In fact, if the firearm could fire with non-aligned articulated connecting rods 142, 143, the sequence described in Figures 7a-g would not be executed because said
20 articulated connecting rods 142 and 143 would kneel immediately without passing through straight guide 137, 138 and without rearming carrier 114.

 In the example, the gun safety device comprises a splined lever 156 that controls, in particular by means
25 of a shaft 161, the position of a safety hook 155. Shaft

161 is parallel to first axis of rotation 153. In more detail, shaft 161 can change its own position relative to first axis of rotation 153 during the recoil. Splined lever 156 has a spline in which a pin 141 integral with
5 first connecting rod 142 is adapted to slide. In particular, pin 141 is located substantially in the centre of first connecting rod 142. In particular, splined lever 156 is rotatably constrained to safety hook 155. In the example there are a pair of splined
10 levers 156, 160, mounted on two opposite sides, e.g. on the right and left sides, of recoiling mass 8. Safety hook 155 is adapted to co-operate with the breechblock.

As a function of its angular position, safety hook 155 is adapted to be engaged with and, respectively,
15 disengaged from a control stud 164 belonging to a lever controlling a spring-type recuperator of a breechblock of the firearm. When safety hook 155 is disengaged from control stud 164, the recuperator allows the breechblock to close. When safety hook 155 is engaged with control
20 stud 164, the recuperator prevents the breechblock from closing. Therefore, when articulated connecting rods 142 and 143 are aligned (horizontally in the drawings), safety hook 155 is disengaged from control stud 164 and the breechblock is allowed to close. Conversely, when
25 articulated connecting rods 142 and 143 are not aligned

(e.g. when they are in the kneeled or bent position), safety hook 155 is engaged with control stud 164 and the breechblock is prevented from closing.

Preferably, there is a fulcrum lever 22 rotatably
5 integral with slotted link lever 62 and having one end hinged to carrier 114. Therefore, fulcrum lever 22 is rotatable about second axis of rotation 21. In particular, the other end of fulcrum lever 22 is rotatably integral with slotted link lever 62. In the
10 example, there are two fulcrum levers 13, 22 mounted symmetrically on both sides of carrier 114.

Conveniently, there is a rearming return means 146 mounted to crank lever 144 to push the first end of crank lever 144 in the direction opposite to a recoil direction
15 of recoiling mass 8. Preferably, rearming return means 146 is a spring, in particular a coil spring, which in the example shown herein works by traction. In Figure 5, rearming return means 146 tends to rotate crank lever 144 clockwise. In more detail, rearming return means 146
20 is mounted to an element, e.g. cradle 102, intended to remain stationary. Preferably, there is a stopper 145, 149 for limiting the rotation of the respective crank lever 144, 148. In particular, stopper 145, 149 limits the rotation induced by rearming return means 146.

25 In the example, the system has its release

transmission connected to carrier 114 and to the rearming transmission, and configured to move carrier 114 from a raised position, in which it can receive a new piece of ammunition 42, to a position proximal to recoiling mass
5 8, in particular in front of the breech of the firearm, to allow piece of ammunition 42 to be inserted into the firearm. In more detail, the release transmission includes release element 84. Conveniently, the release transmission includes unlocking means, particularly
10 mechanical ones, intended to be activated by the piece of ammunition as it falls onto carrier 114, and adapted to disengage release element 84 from rearming lever 93.

The following will describe the operation of the system as a whole with reference to Figures 8a-h.

15 Carrier in the raised position. The piece of ammunition leaves the wait station of the feeding drum, falling onto the chute of carrier 114 (Figure 8a).

Carrier is released. The piece of ammunition has reached carrier 114 and operates the release
20 transmission, thereby starting the ramming operation (Figure 8b).

Carrier is lowered. Carrier 114 goes down under the action of recuperator 10, in order to get aligned with powder chamber and ram piece of ammunition or cartridge
25 42. Rack 61 rotates toothed sector 55 and hence also

fulcrum lever 22, and said fulcrum lever 22 lowers carrier. (Figure 8c).

Carrier 114 has reached its lower position. Carrier 114 is aligned with barrel, and the rammer has rammed
5 the round into the barrel; the release transmission is rearmed (Figure 8d).

Recoil after fire. The carrier rearming transmission, actuated by recoiling mass 8, starts moving carrier 114 back into the raised position;
10 recuperator 60 is recharged. Crank levers 144, 148, pushed by connecting rods 142, 143, rotate counterclockwise and turn rearming lever 93, which turns slotted link lever 62 clockwise. Slotted link lever 62 lifts carrier 114 by means of fulcrum lever 22, and
15 toothed sector 55 causes first piston 63 to be retracted into recuperator 60, thereby recharging said recuperator 60. (Figure 8e).

Gun at 200 mm from battery. The carrier rearming transmission has fully rearmed carrier 114 in the raised
20 position and has engaged the release transmission (Figure 8f).

Gun at maximum recoil position. The carrier rearming transmission frees itself from the motion of recoiling mass 8, bending its articulated connecting
25 rods 142, 143; carrier 114 is engaged in the raised

position by release transmission (Figure 8g).

Return to battery. The carrier rearming transmission is brought back into the starting position by recoiling mass 8; carrier 114 is ready to receive
5 another round (Figure 8h).

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In the example illustrated herein, the release transmission has one or more retaining rods 10, 11 adapted to assume an open position (e.g. as in Fig. 8a)
10 to receive a piece of ammunition 42, and a closed position to retain the piece of ammunition 42. A release lever 15 is adapted to be actuated by the fall of the piece of ammunition 42, and is configured to drive a shaft 29 adapted to control the position of retaining
15 rods 10, 11. After piece of ammunition 42 has fallen, said shaft 29 is ready to bring retaining rods 10, 11 into the closed position. Shaft 29 is also adapted to cause a release piston 32 to come out.

In particular, the release transmission includes:
20 a permission lever 91 adapted to be released by a cartridge case extracted from the firearm; a release lever 92 adapted to retain permission lever 91 after it has been released by the cartridge case. As it moves, release piston 32 turns release lever 92, which frees
25 permission lever 91, which 91 then rotates under the

action of an elastic means.

Through a transmission, permission lever 91 causes release element 84 to move (in particular, to rotate). Release element 84 releases rearming lever 93, which can
5 now rotate. In particular, the transmission includes two rods 85 interposed between permission lever 91 and release element 84. A rod 85 is hinged to permission lever 91 and to a revolving support 86, while the other rod 85 is hinged to the revolving support and to release
10 element 84. In particular, revolving support 86 is adapted to turn about a fixed axis of rotation, e.g. an axis which is fixed relative to cradle 102.

In general, the release transmission comprises:

- retaining means, in particular retaining rods 10,
15 11, adapted to assume an open position to receive the piece of ammunition 42, and a closed position to retain the piece of ammunition 42;

- releasing means, such as a release lever 15,
adapted to be actuated by the fall of the piece of
20 ammunition 42 and configured to control the position of the retaining means, wherein, after the fall of the piece of ammunition 42, such releasing means bring the retaining means into the closed position;

- a permission lever 91 adapted to be released by
25 a cartridge case extracted from the firearm;

- a release lever 92 adapted to retain the permission lever 91 after it has been released by the cartridge case;

wherein, after the fall of the piece of ammunition
5 42, such releasing means are adapted to rotate release lever 92 to free permission lever 91, which 91 will then rotate due to the effect of an elastic means;

wherein permission lever 91 causes, by means of a transmission, the motion of release element 84.

10 Therefore, the release transmission is configured in a manner such that the fall of the piece of ammunition 42 onto carrier 114 will cause release element 84 to disengage from rearming lever 93, thereby permitting the rotation of said rearming lever 93.

15 With reference to Fig. 8d, the release transmission has an upper lever 14 rotatable about an axis of rotation and hinged to carrier 114. Upper lever 14 is adapted to abut on shaft 29 to bring retaining rods 10, 11 into the open position when carrier 114 is in proximity to a
20 lowered position (in other words, when it is close to its lower stopper). In particular, upper lever 14 actuates an angle lever 33 acting upon shaft 29. This results in piece of ammunition 42 being released, which can thus be inserted into the barrel, specifically by
25 means of a rammer 2 associated with carrier 114. In the

example, upper lever 14 has a cam 116 acting upon angle lever 33.

In the position shown in Fig. 8d, an oscillating lever 106 of the release transmission rotates, due to the motion of carrier 114, permission lever 91, which turns release lever 92 until such levers 91 and 92 assume a locking position not allowing carrier 114 to come down (in the example, such position is the one shown in Fig. 8a). In this position, such levers 91 and 92 bring, through the transmission, release element 84 into an engagement position in which it 83 is ready to engage rearming lever 93. Therefore, the system for decoupling a carrier according to the invention uses most of the energy of recoiling mass 8 after firing, and this makes it possible to carry out many mechanical operations for picking up the piece of ammunition and, by means of carrier 114, moving it close to the breechblock for inserting it into the firearm, and for bringing carrier 114 back home to receive the next piece of ammunition. Such a system is fast and reliable, and permits the automatic execution of numerous operations, thus minimizing the need for external actuators. It is thus possible to obtain, in reliable conditions, a high firing rate.

The invention also concerns a firearm and/or a

vehicle comprising a system for decoupling a carrier according to the invention.

Of course, without prejudice to the principle of the invention, the forms of embodiment and the
5 implementation details may be extensively varied from those described and illustrated herein by way of non-limiting example, without however departing from the scope of the invention as set out in the appended claims.

CLAIMS

1. System for decoupling a carrier for a piece of ammunition (42) of a firearm, comprising:
- a carrier recuperator (60), including: a first and
5 a second cylinder (111, 112) respectively comprising a first and a second piston (63, 67); wherein each piston (63, 67) defines, in the respective cylinder (111, 112), a primary chamber (16, 66) full of liquid, and the two primary chambers (16, 66) are in fluidic communication
10 with each other to allow a flow of liquid; the second piston (67) defines, in the second cylinder (112), a secondary chamber (68) containing a return medium for moving the second piston (67) and pumping the liquid into the primary chamber (16) of the first cylinder
15 (111);
 - a carrier rearming transmission, comprising:
 - a first and a second articulated connecting rod (142, 143) hinged to a fulcrum (158), wherein the first connecting rod (142) is also hinged to a
20 recoiling mass (8) of a firearm,
 - a straight guide (137, 138) whereon the articulated connecting rods (142, 143) are intended to abut and slide,
 - a rearming lever (93) freely rotatable about a first
25 axis of rotation (153), and having a slider (154)

at a first end thereof,

- a slotted link lever (62) rotatable about a second axis of rotation (21), and having a guide in which the slider (154) of the rearming lever (93) is slidably mounted, wherein the first piston (63) is connected to the slotted link lever (62) in such a way as to constrain the motion of the first piston (63) to the rotation of the slotted link lever (62),
 - a crank lever (144, 148), rotatable about the first axis of rotation (153), having a first end connected to the recoiling mass through the two articulated connecting rods (142, 143), and configured to interfere with the rotation of the rearming lever (93),
 - a release transmission configured to guide the movement of the carrier (114) and to selectively hold in position and release the rearming lever (93); wherein the first piston (63) is connected to the release transmission in such a way as to constrain the motion of the first piston (63) to a movement of the carrier (114).
2. System according to claim 1, wherein the return medium in the secondary chamber (68) is a gas.
3. System according to claim 1 or 2, wherein the release transmission comprises a release element (84)

which is movable and configured to selectively hold in position and release one end of the rearming lever (93).

4. System according to claim 3, wherein the release element (84) is constrained to the carrier (114), so
5 that the position of the carrier (114) determines the position of the release element (84).

5. System according to claim 3 or 4, wherein the release element (84) is rotatable about an axis of rotation of its own.

10 6. System according to any one of the preceding claims, wherein the slotted link lever (62) is integral with a toothed sector (55) engaged with a rack (61) integral with the first piston (63).

7. System according to any one of the preceding claims,
15 comprising a fulcrum lever (22) rotatably integral with the slotted link lever (62) and having one end hinged to the carrier (114).

8. System according to any one of the preceding claims, comprising a rearming return means (146) mounted to the
20 crank lever (144) to push the first end of the crank lever (144) in a direction opposite to a recoiling direction of the recoiling mass (8).

9. System according to any one of the preceding claims, wherein the release transmission is connected to the
25 carrier (114) and to the rearming transmission, and is

configured to move the carrier (114) from a raised position, in which it can receive a new piece of ammunition (42), to a position close to the recoiling mass (8), allowing the piece of ammunition (42) to be
5 inserted into the firearm.

10. System according to claim 9, wherein the release transmission has unlocking means adapted to be activated by the piece of ammunition (42) as it falls onto the carrier (114), and adapted to disengage the release
10 element (84) from the rearming lever (93).

11. System according to claim 10, wherein the release transmission comprises:

- retaining means, in particular retaining rods (10, 11), adapted to assume an open position to receive the
15 piece of ammunition (42), and a closed position to retain the piece of ammunition (42);
- releasing means, such as a release lever (15), adapted to be actuated by the fall of the piece of ammunition (42) and configured to control the position
20 of the retaining means, wherein, after the fall of the piece of ammunition (42), such releasing means bring the retaining means into the closed position;
- a permission lever (91) adapted to be released by a cartridge case extracted from the firearm;
- 25 - a release lever (92) adapted to retain the

permission lever (91) after it has been released by the cartridge case;

wherein, after the fall of the piece of ammunition (42), such releasing means are adapted to rotate the release lever (92) to free the permission lever (91),
5 which (91) will then rotate due to the effect of an elastic means;

wherein the permission lever (91) causes, by means of a transmission, the motion of the release element
10 (84).

12. System according to claim 11, wherein the transmission includes two rods (85) interposed between the permission lever (91) and the release element (84).

13. System according to any one of the preceding claims,
15 wherein the recuperator (60) is configured to accumulate energy from the recoiling mass (8) after the recoil, and to release such energy for lowering the carrier (114).

14. System according to any one of the preceding claims, wherein the rearming transmission comprises an idle
20 lever (151), rotatable about the first axis of rotation (153) and rotatably constrained to the crank lever (144, 148); wherein the idle lever (151) is adapted to abut against a second end of the rearming lever (93).

15. System according to any one of the preceding claims,
25 including a gun safety device (147) configured to prevent

the complete closing of a breechblock of the firearm until the articulated connecting rods (142, 143) are aligned.

16. System according to claim 14, wherein the gun safety
5 device (147) comprises a splined lever (156) that controls the position of a safety hook (155); wherein the splined lever (156) has a spline in which a pin (141) can slide, which is integral with the first connecting rod (142); wherein the splined lever (156) is rotatably
10 constrained to the safety hook (155).

17. Firearm comprising a system according to any one of the preceding claims.

18. Vehicle comprising a system according to any one of claims 1 to 16.

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